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SECTION A OF SCIENCE ABSTRACTS

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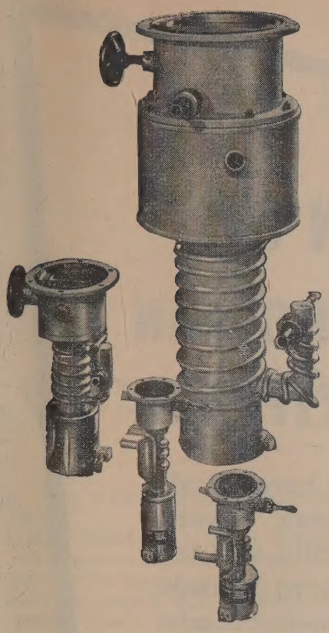

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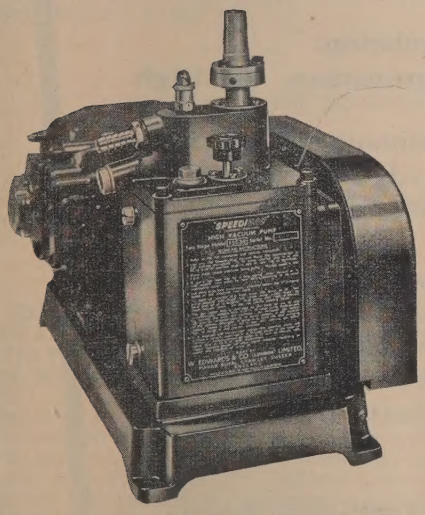

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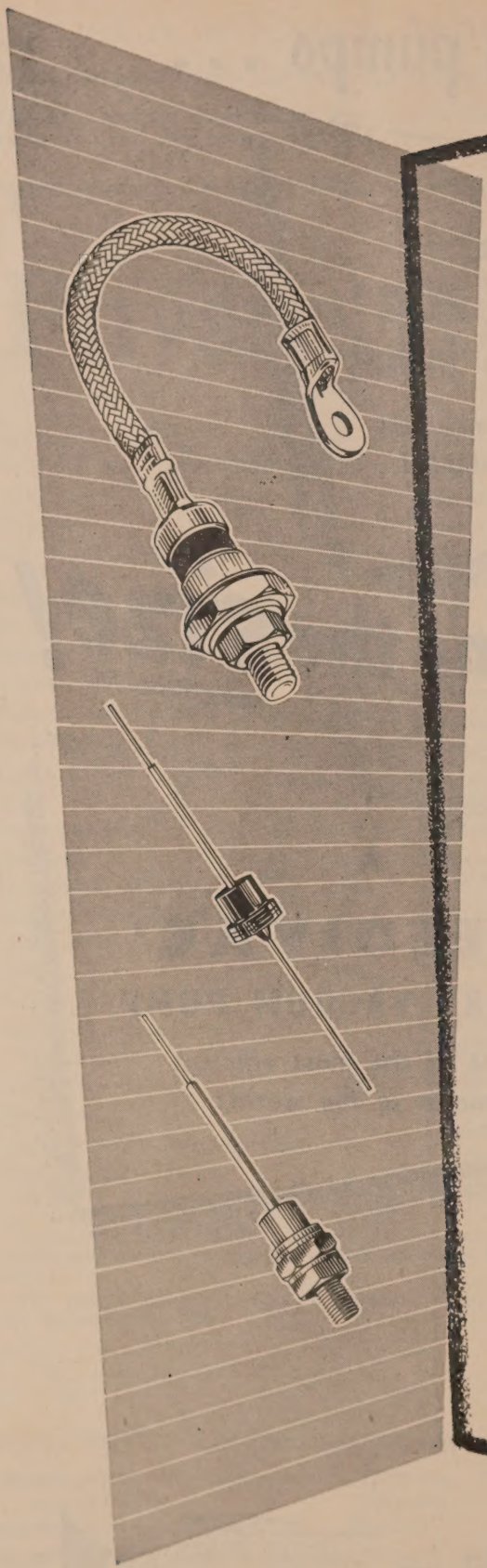

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PHYSICS ABSTRACTS

olume 61 AUGUST 1958 Number 728

MATHEMATICS

517.3 : 535.1 : 538.56

INTERACTION OF RADIATION WITH A BODY. EVALUATION F $\int Vdv/R^2$. See Abstr. 4162

517.43

17. TAYLOR'S THEOREM FOR SHIFT OPERATORS. A.Sack.
iil. Mag. (Eighth Ser.), Vol. 3, 497-503 (May, 1958).

An expansion equivalent to Taylor's series is derived for nctions of two operators of the form F(A + B), where B is a shift erator with regard to A; the result is obtained as a special case a theore n due to Kermack and McCrea. The development in wers of B involves finite differences of the function F(A) instead derivatives as in the case of commuting variables. Exponential nctions can be factorized into two terms, each depending on one erator only. The result allows a Gaussian potential energy to be pressed as a product of exponentials involving only creation and struction operators. Explicit results are derived for the matrix ements of such a Gaussian function in the representations which agonalize the Hamiltonians of the harmonic oscillator in one and o dimensions; they can be expressed in terms of Jacobi polynomials nite hypergeometric series). A.

517.63 : 621.372.6

4618. RELATIONS BETWEEN THE LAPLACE TRANSFORMATION AND INFINITE SERIES. J.Wetzger. Frequenz, Vol. 12, No. 5, 155-9 (May, 1958). In German.

Connections between functional transformations, such as the Laplace transformation and infinite series, are utilized to study the properties (convergence and representation by analytic functions) of the latter. The methods described are applied to a particular Dirichlet series. M.J.Kearsley

518.5 : 621.374.32 : 681.142

4619. DIGITAL FIELD COMPUTERS. B.Meltzer and I.F.Brown. Nature (London), Vol. 181, 1384-5 (May 17, 1958).

The limitations of conventional digital computers for the solution of partial differential equations motivate the proposal of a new kind of non-universal computer, which employs a lattice of identical computer units; one such unit is associated with each point of the finite-difference lattice of points of the field of the independent variables. The integral number N is represented by a train of N pulses, and the time of the computation is the duration of the longest number handled. The use of identical simple and basic units for the synthesis of lattice units, and the logic of these units for a class of fields including that of potential, are described. Reading, power requirements and cost are briefly discussed. B.Meltzer

518.5 : 539.378.3 : 532.72 : 681.142 : 621.317.79

NEW INTEGRATING CIRCUIT AND ELECTRICAL ANALOGUE FOR TRANSIENT DIFFUSION AND FLOW. See Abstr. 3771

ASTRONOMY . ASTROPHYSICS

522.24 : 535.317.23

20. EXPERIMENTAL STUDY OF THE DEFECTS OF THE IAGE OF A STAR AS A FUNCTION OF THE DIAMETER OF THE BJECTIVE USED [IN A TELESCOPE]. J.Rösch.
R. Acad. Sci. (Paris), Vol. 246, No. 4, 559-61 (Jan. 27, 1958). French.

Report on observational work to study the intensity-changes, the ovements, and the blurring of telescopic images in their depend-ce on the aperture of the telescope. Theoretical expressions ven in C.R. Acad. Sci. (Paris), Vol. 246, No. 3, 384 (Jan. 20, 1958), e confirmed. The experimental arrangement discussed in R. Acad. Sci. (Paris), Vol. 244, No. 25, 3027 (June 17, 1957), has en improved, and some new conclusions concerning the minimiz-ion of seeing effects are indicated. A.Beer

522.61

21. A NEW INSTRUMENT FOR OBSERVING THE ELECTRON ORONA. G.Wlérick and J.Axtell.
trophys. J., Vol. 126, No. 2, 253-8 (Sept., 1957).

An instrument for measuring and recording the brightness of e polarized component of the light scattered by the solar electron rona has been developed and is mounted for operation on the 26-ot equatorial spar of the High Altitude Observatory at Climax, lorado. It has three principal features of design: (a) the polariza-n produced internally is kept at a very low level ($< 10^{-4}$) by using strictly on-axis optical system and by careful compensation for sidual polarization; (b) the scattered photospheric light is mini-zed, as in a conventional Lyot coronagraph; and (c) the brightness the polarized light is measured with a sensitive photoelectric polarimeter using electro-optic modulation of the light-beam. Test operation of the instrument in Boulder has resulted in the detection of the electron-coronal light from coronal regions about 0.5 solar radii from the limb and, in one case, at 0.66 solar radii from the limb. A.

522.61

4622. HIGH RESOLUTION CINEMATOGRAPHY OF THE SOLAR PHOTOSPHERE. R.E.Loughhead and V.R.Burgess.
Austral. J. Phys., Vol. 11, No. 1, 35-40 (March, 1958).

A description is given of a new photoheliograph designed for time-lapse cinematography on 35 mm film of any selected portion of a 20 cm solar image. The interval between successive photographs can be varied from 5 to 120 sec. Air-suction devices have been incorporated to suppress bad seing originating within the telescope. The performance of the telescope is briefly discussed and the advantages of the cinematographic technique indicated. A discussion of the effects of atmospheric seeing is given in order to emphasize the great caution needed in the interpretation of solar photographs. A.

522.614 : 535.24

4623. A HIGH-RESOLUTION ISOPHOTOMETER. O.C.Mohler and A.K.Pierce.
Astrophys. J., Vol. 125, No. 1, 285-6 (Jan., 1957).

The instrument is a modified microdensitometer. It has two advantages: (1) it is completely automatic in operation; (2) the accuracy of the intensity levels can be made very high. A.

523.11 : 537.591

4624. GALACTIC TURBULENCE AND THE ORIGINS OF COSMIC RAYS AND THE GALACTIC MAGNETIC FIELD. J.H.Piddington.
Austral. J. Phys., Vol. 10, No. 4, 515-29 (Dec., 1957).

A new absorption mechanism is discussed in relation to the turbulence of the interstellar gas in the presence of a magnetic field. It is evaluated and compared with ordinary viscous absorption in different types of interstellar gas. Wherever there is a proportion, even though very small, of neutral atoms (helium being most likely) the new mechanism predominates for waves if length comparable with one parsec or more. The fact that hydromagnetic shear waves, either travelling or standing waves, of length about one parsec are heavily damped provides evidence against Fermi's theory of cosmic rays. The new difficulty must be faced for any of the recent formulations of the theory, only being absent when the gas is fully ionized. The mechanism also raises additional difficulties in explaining the observed irregular motion of the HI gas clouds. The rate of dissipation of magnetic energy is found the same for hydromagnetic waves and for non-oscillatory distortions of the field; even for a field in a solid conductor. The dissipation time depends only on the conductivity and the size of the irregularities in the field. Theories of spontaneous growth of magnetic fields are discussed critically and a minimum criterion of growth is suggested. A.

523.161 : 534.222.2

4625. THE ENERGY DISSIPATION, HEATING AND IONIZATION OF INTERSTELLAR GAS BY SHOCK WAVES. S.B.Pikel'ner
Astron. Zh., Vol. 34, No. 3, 314-20 (1957). In Russian.

An attempt is made to estimate these quantities assuming that the magnetic energy density is equal, on the average, to the kinetic energy density, and that it is much greater than the thermal energy of the gas. It is shown that the cosmic-ray pressure has a small effect. The presence of a magnetic field decreases the energy dissipation by a factor of 20-30. If it were possible to estimate the gas temperature or ionization from observations, then the calculations reported in this paper could be used to estimate the energy dissipation, the gas density and the magnetic field. S.Chomet

523.164

4626. THE EXPLORATION OF SPACE BY RADIO.
R.H.Brown and A.C.B.Lovell.
London: Chapman and Hall (1957) xii + 207 pp.

Reviews present state of knowledge of the radio universe and its exploration under the following chapter headings: Astronomical background; Some properties of radio waves; Techniques of radio astronomy; Galactic and extragalactic radio emissions; Hydrogen line; Scintillation of radio stars; Solar radio waves; Meteors; Radio and the aurora borealis; Radio investigation of the moon, planets and the earth satellite; Jodrell Bank radio telescope.

523.164

4627. A MECHANISM OF NON-THERMAL RADIO-NOISE ORIGIN. W.C.Erickson.
Astrophys. J., Vol. 126, No. 3, 480-92 (Nov., 1957).

A mechanism is proposed. The action of this mechanism may be summarized in the following manner. Suppose that clouds of interstellar grains exist in the radio-source regions. If a high-velocity gas cloud collides with a cloud of grains, the grains will be bombarded by moderately fast atoms and/or ions. These collisions will transfer angular momentum to the grains, and in fact, the angular velocity of each grain will execute a dynamical "walk". It is shown that rotational frequencies comparable with radiofrequencies may be attained. If some of the grains possess electric or magnetic dipole moments due to polar or ferromagnetic substances or statistical fluctuations in the distribution of charge on the grains, they will radiate calssically at radiofrequencies. Rather improbably high grain densities are required in order to account for the total radio-frequency radiation of high-emissivity sources. However, the high-frequency portion of this radiation could be generated with moderate grain densities. A.

523.164

4628. A STATISTICAL METHOD FOR ANALYSING OBSERVATIONS OF FAINT RADIO STARS. P.A.G.Scheuer.
Proc. Cambridge Phil. Soc., Vol. 53, Pt 3, 764-73 (July, 1957).

The observation of faint radio sources is often limited by the angular resolving power of the radio-telescope, and not by its sensitivity. Continuous recording of the output from the receiving apparatus then produces a trace which always shows the sum of the effects of a number of sources in the reception pattern, instead of showing sources passing through the reception pattern one at a time. The apparent intensities of sources found on the records are affected by the presence of several other, fainter, sources in the reception pattern, and even the existence of many of the faint sources is doubtful. Counts of numbers of sources at given intensity levels are therefore unreliable. Any assumed number-intensity law for radio sources can, however, be tested by a method free from the uncertainties due to confusion between adjacent sources, using a direct relation between the number-intensity law and the frequency distribution of deflections of various sizes on the observed records. The present paper shows the derivation of the relation between M(I)dI, the mean number of radio sources per steradian in the intensity interval dI, and P(D)dD, the probability that the deflection D recorded at an arbitrary instant lies in the interval dD. Expressions for P(D) are worked out for some specific models of M(I); a comparison with observation was given in an earlier paper (Abstr. 6689/1955). A

523.164.08

4629. A LARGE [RADIO] INTERFEROMETER AT NANÇAY.
E.J.Blum, A.Boischot and M.Ginat.
Ann. Astrophys., Vol. 20, No. 4, 155-64 (1957).
In French.

This interferometer has 32 aerials, each one with a diameter of 5 m, set on a E—W base 1550 m long. It gives information on the position and dimensions of the radio centres of activity at the surface of the sun. A.

523.164.32 : 523.75

4630. THE ASSOCIATION OF SOLAR RADIO BURSTS OF SPECTRAL TYPE III WITH CHROMOSPHERIC FLARES.
R.E.Loughhead, J.A.Roberts and M.K.McCabe.
Austral. J. Phys., Vol. 10, No. 4, 483-90 (Dec., 1957).

The relationship of radio bursts of spectral type III to solar flares is investigated by comparing simultaneous optical and radio observations. Over 300 flares are examined, 85% of which are microflares (class 1—). About 20% of the flares are associated with type III events, while more than 60% of the bursts recorded occur during the lifetime of a flare. These bursts tend to occur near the beginning of the flare or even to precede it slightly. The degree of association varies markedly over a period of days. Flares occurring in certain activity regions show a high degree of correlation with bursts, while those occurring in other regions show little of no correlation. The probability of a burst accompanying a flare is greater for larger flares. It is essentially the same for flares on the eastern limb as for flares in the centre of the disk, implying a wide cone of escape for type III radiation. There is an apparent deficit for flares on the western hemisphere. The occurrence of a surge with a flare appears to increase somewhat the likelihood of an associated radio event. A.

523.164.32

4631. THE DISTRIBUTION OF RADIO BRIGHTNESS OVER THE SOLAR DISK AT A WAVELENGTH OF 21 CENTIMETRES. IV. THE SLOWLY VARYING COMPONENT.
W.N.Christiansen, J.A.Warburton and R.D.Davies.
Austral. J. Phys., Vol. 10, No. 4, 491-514 (Dec., 1957).

For Part II see Abstr. 4777 (1956). A large number of highly emitting regions on the sun have been studied individually by means of a 32-element interferometer which produces fringes 3' wide at a wavelength of 21 cm. These regions are responsible for the slowly varying component of the solar radiation at decimetre wavelengths. The radio sources appear always to be associated with plages faculaires and, during the years 1952-53, were found to lie about 22 000 km above them. The observations showed that the sources, when resolved, appeared to have the same size as the associated plages. The angular distribution of flux from radio sources was found to follow approximately a cosine law, which suggests that a source has the form of a thin sheet, lying parallel to the surface of the sun. The observations throw light on conclusions reached from the statistics of whole-sun observations. A high correlation exists between radio flux and sunspot area in an active region in the period when both are near their peak. In the period of decay, however, the radio flux decreases more slowly than the sunspot area. A.

523.164.4

4632. ABSOLUTE MEASUREMENTS OF WEAK FLUX DENSITIES OF 900 Mc/s RADIATION.
J.Delannoy, J.F.Denisse, E.Le Roux and B.Morlet.
Ann. Astrophys., Vol. 20, No. 6, 222-37 (1957).
In French.

Absolute measurements of weak flux densities were carried out on the frequency of 900 Mc/s. The methods of measurement

re described in detail and the errors are discussed. Flux density r the most intense radio-sources are given together with a easure of the sky brightness. A.

523.164.4

633. BETWEEN THE ATMOSPHERICS. G.Reber.
geophys. Res., Vol. 63, No. 1, 109-23 (March, 1958).

Examination is made of the residual intensity of energy eceived between the atmospherics at a frequency of 520 kc/s. he nature of the junction between the earth's and the sun's atmo- here, and the manner in which an electromagnetic wave travels rough an overdense ionosphere are briefly described. The way which an ionospheric shutter opens and closes is explained, gether with exa nples shown and reduced. A celestial component found at declination -6°, which has a maximum at 220 hr right scension and a minimum at 0700 hr. The maximum intensity is $\times 10^{-20}$ jansky/sterad. Unexpected variations at night may be due auroral particles of low energy. Manifestations of strong recipitation static and local atmospherics are described. A few bservations were made at 143 kc/s. A.

523.164.4

634. AURORAL ABSORPTION OF 18 Mc/s COSMIC RADIO AVES ON FEBRUARY 11, 1958. R.Fleischer.
ature (London), Vol. 181, 1156 (April 19, 1958).

A record of the reception is reproduced, which shows absorption the order of 10 dB, believed to be associated with the great roral activity on this date. The observations for February 12 so show some slight absorption. (Position of observatory: $^{\circ}$ 47' N, 73° 27' W.) M.W.Ovenden

523.164.4

635. ABSORPTION OF COSMIC RADIO NOISE DURING THE REAT AURORA OF 11 FEBRUARY 1958. J.W.Warwick.
ience, Vol. 127, 1047-8 (May 2, 1958).

Records of the absorption of galactic radio noise on a frequency 18 Mc/s at Boulder, Colorado, during the night of the intense rora showed that this was distinctly lowered and only recovered normal after about 3 days. Possible explanations in terms of th F2 and D region absorption are offered. G.M.Brown

523.164.42

636. COUNTS OF EXTRAGALACTIC RADIO SOURCES AND NIFORM MODEL UNIVERSES. G.C.McVittie.
ustral. J. Phys., Vol. 10, No. 3, 331-50 (Sept., 1957).

The radio sources are assumed to be galaxies sharing in the d-shift phenomenon. The counts of such sources to successive mits of flux density are interpreted in terms of the model universes general relativity. The flux density in each infinitesimal interval frequency is assumed to be proportional to a power of the frequen- and to a multiplicative parameter, both these quantities being garded as functions of the red-shift, i.e. of the time of travel of e radiation. All sources at the same distance from the observer re assumed to be identical radiators; this permits the introduction a standard comparison source. The data in the Sydney catalogue n then be interpreted in terms of radio sources of constant strength .e. those which are independent of the red-shift) if they are similar NGC 1275, taken as standard. If they are similar to Cygnus A, e data imply that the sources were radiating more strongly when eir radiation left them than is Cygnus A now. This type of con- usion appears to be unavoidable for the data of the Cambridge talogue. It is briefly explained how to modify the theory to take count of a variation with time of the space-density of sources and so of a mixture of comparison sources. A.

523.164.42

637. FURTHER OBSERVATIONS OF RADIO EMISSION FROM HE PLANET JUPITER. F.F.Gardner and C.A.Shain.
ustral. J. Phys., Vol. 11, No. 1, 55-69 (March, 1958).

The observations were made near Sydney from June 1955 to arch 1956. Most work was done at 19.6 Mc/s, but some observa- ons were also made at 14 and 27 Mc/s. The characteristics of the .6 Mc/s radiation received from Jupiter are described in detail. he new facts disclosed by these observations are: (1) Jupiter diation appeared to be random noise varying rapidly in intensity - large changes in intensity took place in times as short as 0.2 sec, t no shorter; (2) some spaced-receiver observations indicated at the terrestrial ionosphere can have a pronounced effect on the ort-term characteristics of the radiation; (3) a single observation owed that on that occasion the radiation was circularly polarized ight-handed in radio sense). There appeared to be three sources noise on Jupiter. None of these could be identified with visual features. The radiation emitted from the main source was confined to angles within 45° of a central line. The additional observations at 14 and 27 Mc/s showed that the peak intensity, mean duration, and frequency of occurrence were all greatest at 19.6 Mc/s. Two of the radio sources were active at 19.6 Mc/s but not at 27 Mc/s. The angular spread of the radiation from the principal source was considerably narrower at 27 Mc/s than at 19.6 Mc/s. The great variability and spectral concentration of the Jupiter radiation, both resembling solar noise, suggest an origin in some form of plasma oscillation in an ionized region with a critical frequency around 20 Mc/s. A.

523.164.42

4638. RADIO STARS AND THE METHODS OF THEIR INVESTIGATION. V.V.Vitkevich.
Astron. Zh., Vol. 34, No. 3, 349-64 (1957). In Russian.

Ryle's results on the distribution of radio stars are summarized and discussed. The results can be interpreted in terms of either a constant density of sources and a luminosity which is a function of distance, or by a constant luminosity and a variable density. If one could measure the angular sizes of radio stars, then it would be possible to choose between these alternatives. A system is suggested whereby such a measurement could be carried out, at least in principle, and possibly in practice. S.Chomet

523.164.85

4639. SOME PROPERTIES OF OBLIQUE RADIO REFLECTIONS FROM METEOR IONIZATION TRAILS.
O.G.Villard, Jr, A.M.Peterson, L.A.Manning and V.R.Eshleman.
J. geophys. Res., Vol. 61, No. 2(1), 233-49 (June, 1956).

Certain characteristics of radio signals, propagated by reflection from meteor ionization trails from a low-power continuous-wave transmitter 960 km distant, were studied at radio frequencies of 23.2, 46.4 and 92.8 Mc/s. In particular, the per cent of the total time that meteor reflections were detectable at each frequency is presented, and shown to be in qualitative agreement with theoretical expectations. Simultaneous recordings were also made of signals from a second remote transmitter operated at 23.1, 46.2 and 92.4 Mc/s, and located at various distances along, and at right-angles to, the propagation path. From the per cent time that signals received from the second transmitter were coincident with those from the first, it is concluded that re-radiation from the numerous, low-density trails is highly directional, and that the fading, long-enduring echoes from the relatively-infrequent, high-density trails are considerably less directional. When the transmitters were spaced in a direction perpendicular to the propagation path, the signal coincidence decreased much more rapidly with transmitter spacing than when the transmitters were spaced along the propagation path. A.

523.164.85

4640. A THEORY OF LONG-DURATION METEOR-ECHOES BASED ON ATMOSPHERIC TURBULENCE WITH EXPERIMENTAL CONFIRMATION. H.G.Booker and R.Cohen.
J. geophys. Res., Vol. 61, No. 4, 707-33 (Dec., 1956).

A theory of long-duration meteor-echoes is developed, based on the assumption that a meteor-trail is rendered rough by the action of the small eddies in the atmosphere. This theory leads to the conclusion that, if loss of electrons from the trail by recombination or attachment, or both, is neglected, the field-strength of a long-duration meteor-echo in its decay-phase should be inversely proportional to the cube of the time subsequent to the formation of the trail. It is shown that this law is verified experimentally in the early part of the decay, but that at later times the decay becomes more rapid. This can be explained in terms of the loss of electrons from the trail, provided that the loss is due to attachment to atmospheric molecules and the attachment time has an average value of the order of seven seconds. It is shown that the spectrum of incoherent scattering associated with turbulent mixing in a gradient of electron-density may be derived experimentally by measuring the frequency-dependence of long-duration meteor-echoes during their decay-phase. This measurement is carried out, and the results are related to the experiments of Central Radio Propagation Laboratory (Colorado) concerning the frequency-dependence of long-distance v.h.f. scatter-transmission. It is deduced that the contribution of meteoric ionization to the background-signal of scatter-transmission arises mainly from the incoherent scattering associated with mixing of this ionization by atmospheric turbulence. According to the present analysis, McKinley's data concerning the contribution of meteor-trails to scatter–transmission lead to the same conclusion. A.

523.164.85

4641. DISCUSSION OF THE BOOKER AND COHEN PAPER, "A THEORY OF LONG-DURATION METEOR ECHOES BASED ON ATMOSPHERIC TURBULENCE WITH EXPERIMENTAL CONFIRMATION". L.A.Manning and V.R.Eshleman.
J. geophys. Res., Vol. 62, No. 3, 367-71 (Sept., 1957).

The experimental evidence offered in support of Booker and Cohen's theory (see preceding abstract) is examined point-by-point. It is concluded that the theory does not accurately represent the properties of meteoric echoes. A.

523.165 : 537.591

4642. COSMIC-RAY MODULATION BY SOLAR WIND. E.N.Parker.
Phys. Rev., Vol. 110, No. 6, 1445-9 (June 15, 1958).

It is shown that the hydrodynamic outflow of gas from the sun observed by Biermann results in a reduction of the cosmic-ray intensity in the inner solar system during the years of solar activity. The computed cosmic-ray energy spectrum so closely resembles the observed spectrum at earth that the author suggests the outflow of gas to be the explanation for the 11-year variation of the cosmic-ray intensity. It is also suggested that perhaps the Forbush-type decrease, which is a local geocentric phenomenon, is the result of disordering of the outer geomagnetic field by the outflowing gas from the sun. A.

523.36

4643. CALCULATIONS OF LUNAR TEMPERATURES. R.W.Muncey.
Nature (London), Vol. 181, 1458-9 (May 24, 1958).

It is suggested that account must be taken of the variation of conductivity and specific heat with temperature. Observational data may be explained if these quantities are assumed to be proportional to the absolute temperature. R.A.Newing

523.45

4644. THE EQUATORIAL CLOUDS OF JUPITER. P.Squires.
Astrophys. J., Vol. 126, No. 1, 185-94 (July, 1957).

The observations of Hess (Abstr. 17/1954) lead to the view that the equatorial clouds are cumuliform, the tops reaching some 20-30 km above the main cloud deck. On this hypothesis, the observations are consistent with a temperature at the level of the main deck considerably in excess of 170°K. A.

523.5 : 523.164.85

4645. THE INITIAL RADIUS OF METEORIC IONIZATION TRAILS. L.A.Manning.
J. geophys. Res., Vol. 63, No. 1, 181-96 (March, 1958).

The formation about the path of a meteor of regions of ionized and neutral atoms of meteoric material is investigated from the viewpoint of kinetic theory. It is found that the high initial velocity of the diffusing particles causes the trail to quickly reach an "initial radius" from which normal diffusion then proceeds. It is shown that the reflected signal may for most purposes be computed on the assumption that the trail reaches this initial radius instantaneously. The value of the initial radius is approximately 14 mean-free-paths; it is thus greater for the neutral than for the ionized trail. It is shown that at very high frequencies the initial radius may reduce the amplitude of the returned signal from under-dense trails by as much as 50 dB. If heating is neglected, it is shown that the effect of initial radius on over-dense trails is marked at the same heights and frequencies as for under-dense trails. A.

523.51

4646. INVESTIGATION OF THE SOLID CONSTITUENT OF INTERPLANETARY MATTER USING ROCKETS AND ARTIFICIAL EARTH SATELLITES.
S.M.Poloskov and T.N.Nazarova.
Uspekhi fiz. Nauk, Vol. 63, No. 1b, 253-65 (1957). In Russian.

Review article concerned particularly with the determination of the flux of meteorite particles and with the determination of their kinetic energy or momentum. C.R.S.Manders

523.53

4647. THE INCIDENCE OF METEOR PARTICLES UPON THE EARTH. A.A.Weiss.
Austral. J. Phys., Vol. 10, No. 3, 397-411 (Sept., 1957).

Radio echo rates for both shower and sporadic meteors, measured at Adelaide with the 27 Mc/s C.W. equipment, are applied to the calculation of the incident flux of meteors above limiting brightnesses in the range $M_R < +7.5$. On the hypothesis of a strongly velocity-dependent ionizing probability, reached after a critical evaluation of the observational material, the meteor flux above prescribed limiting meteor particle masses, and the space densities of meteor particles, are also calculated. These fluxes and densities agree reasonably well with independent evaluations from visual meteor rates. The amount of meteoric matter falling on the whole earth per day within the particle mass limits 10^{-1} to 10^{-4} g, for sporadic meteors and some showers, is also estimated. A.

523.5

4648. THE 1956 PHOENICID METEOR SHOWER. A.A.Weiss.
Austral. J. Phys., Vol. 11, No. 1, 113-17 (March, 1958).

From radio observation of this shower at Adelaide the radiant coordinates are estimated to be 15 ± 2, −55 ± 3. The radio record was obtained when the earth was some 6 hr from the centre of the stream. The radio rate of 30 per hr (measured on an equipment of high sensitivity) is much lower than expected from the visual rates of from 20 to 100 per hr reported from 1 to 9 hr later. Echo duration and amplitude are smaller than would be expected from the visual brightness of these meteors. The low radio rate and lack of bright radio meteors could be due to observation on the fringe of the stream or to low ionizing efficiency of slow meteors. A

523.531

4649. METEOR ACTIVITY IN THE SOUTHERN HEMISPHERE. A.A.Weiss.
Austral. J. Phys., Vol. 10, No. 2, 299-309 (June, 1957).

Activities and radiants of meteor showers detected by radio equipments at Adelaide from 1952 to 1956 are summarized. A composite picture of shower and sporadic meteor activity is compared with a similar picture compiled from northern hemisphere radio counts. The distribution of the radiants of the more important showers reveals a pronounced concentration to the ecliptic, with a component extending to high latitudes. A.

523.531 : 523.164.85

4650. METEOR RADIANT DETERMINATION FROM HIGH ECHO-RATE OBSERVATIONS. C.S.L.Keay.
Austral. J. Phys., Vol. 10, No. 4, 471-82 (Dec., 1957).

A simplified analysis is given of the Clegg method (Abstr. 1280, 3683/1949) for delineating meteor radiants from radar observations. A further analysis reveals a new and faster method of interpreting the data contained in meteor echo records. This method is applicable when sensitive equipment is employed and the resulting echo rate is very high. A.

523.57

4651. METEOR WAKES AND THEIR SPECTRA. I.Halliday.
Astrophys. J., Vol. 127, No. 2, 245-52 (March, 1958).

The seven known photographic spectra of meteor wakes are reviewed. Very low levels of excitation predominate. The strong lines of neutral magnesium are possibly present in meteor-wake spectra but are probably absent in high-speed pellet spectra. From the intensities and spectral excitation of wakes it is concluded that they are produced by particles of atomic size rather than by ablation from solid fragments. The excitation mechanism is believed to be atomic collisions. A.

523.6

4652. PRELIMINARY RESULTS OF POLARIZATION MEASUREMENTS IN COMETS. A.Elvius.
Ark. Astron., Vol. 2, Paper 19, 195-7 (1958).

Photographic measurements with the Öhman polarigraph at Stockholm Observatory on Eastman 103a-0 plates indicate polarization values of 18-20% for Comet Arend-Roland (1956h), and ~ 25% for Comet Mrkos (1957d). In both cases the electric vector was perpendicular to the plane, sun-comet-earth. D.R.Barber

523.74

4653. THE NUMBERS AND MOTIONS OF SOLAR SPICULES. R.G.Athay and R.N.Thomas.
Astrophys. J., Vol. 125, No. 3, 804-10 (May, 1957).

Spicule motions are interpreted in terms of two spicule models, one with constant velocity and one decelerating in the solar gravitational field. The available statistics slightly favour the gravitational model, but do not indicate clearly which model is preferred. The total number of spicules on the sun is estimated by fitting the two spicule models to the observed distribution of spicules with height. This leads to total spicule numbers of 1.4×10^4 to 1.3×10^4 for the two models. A.

523.746 : 538.3

4654. ACCELERATION OF CHARGED PARTICLES IN THE ELECTROMAGNETIC FIELD OF SUNSPOTS. P.E.Kolpakov.
Astron. Zh., Vol. 34, No. 2, 222-32 (1957). In Russian.

Observations indicate that charged particles (electrons and

ons) exist in the solar atmosphere. Their number varies with ime, and their energies are 10^5-10^6 eV, and even as much as 0^9 eV. When the magnetic field due to a group of sunspots changes, n associated electric field appears. The acceleration of charged articles by the component of the electric field, perpendicular to the nagnetic field, is considered. This acceleration leads to an increase n the energy of the particles by a factor of 10^3, the maximum final nergy being of the order of 10^8 eV. Because of decelerating effects nly the particles which have initial energies in excess of a certain nitial value can be thus accelerated. This value is a function of the ate of increase of the magnetic field. The component of the induced lectric field parallel to the magnetic field is more effective and it an accelerate particles to energies of 10^8-10^9 eV. S.Chomet

523.75 : 550.385

655. THE RELATION BETWEEN SUDDEN DISAPPEARANCES F [SOLAR] FILAMENTS AND [GEO]MAGNETIC STORMS. I.Dizer.
nn. Géophys., Vol. 13, No. 4, 325 (Oct.-Dec., 1957).

An analysis of solar–geomagnetic data, for the period 1919-947, reveals that of a total of 118 sudden disappearances of disk laments in regions remote from the central meridian, only 9% ere asscoiated with subsequent geomagnetic storms. By contrast, 456 similar disappearances from regions near the central meridian, 02 (22%) could be associated with geomagnetic storm activity. D.R.Barber

523.75

656. FLARE-CONNECTED PROMINENCES. J.W.Warwick.
strophys. J., Vol. 125, No. 3, 811-16 (May, 1957).

Lyman-α observations combined with ionospheric data during lar flares lead to the conclusion that Lyman-α radiation pressure ay contribute appreciably to the forces that cause the sun to eject rtain flare-associated prominences. The curvature of the ajectories followed by the material in these high-velocity promi-nces suggests that rather strong magnetic fields may exist in ronal regions. A.

523.752

657. THE CHROMOSPHERE NEAR ACTIVE REGIONS.
.G.Athay and R.N.Thomas.
strophys. J., Vol. 125, No. 3, 788-803 (May, 1957).

Eclipse data show abnormal chromospheric and coronal emis-on above active sunspot regions. Data for such regions on 1952, 936 and 1932 eclipse spectrograms are analysed and it is shown ow the chromospheric structure differs from normal chromospheric gions. If one assumes that the chromosphere has two components different temperature and density at a given height, one finds that e principal difference between the active regions and the normal gions is a larger proportion of the hotter component in the active gion. One also finds that the temperatures in the two components e relatively unchanged over the active regions, which is consistent th the assumption of thermal stability for the chromospheric radi-ion field (Abstr. 4995/1957). A.

523.752

658. PHYSICAL CONDITIONS IN THE SOLAR LIMB ROMINENCE OBSERVED AT THE 1952 ECLIPSE.
G.Athay and F.Q.Orrall.
strophys. J., Vol. 126, No. 1, 167-76 (July, 1957).

At the time of the 1952 eclipse a small, rather faint, prominence as located near the equator on the west solar limb. Redman and nstra (1952) have previously discussed the continuous spectrum of is prominence, and this paper discusses the line spectrum. By mbining the line data with the continuum data, the following con-usions are reached: (1) the optical thickness of the central part of e prominence in the centre of Hα is less than or near unity, and ne of the observed hydrogen- and helium-line intensities are riously affected by self-absorption; (2) the hydrogen energy levels d the helium triplet energy levels are overpopulated relative to the ermodynamic equilibrium populations at T_e; (3) helium is pre-minantly singly ionized; (4) T_e is near 20 000° and $n_e \geq 10^{11}$; and the prominence is in a steady state, with its radiated energy lanced by an external energy supply. A.

523.752

659. CORONAL STREAMING IN SOLAR SUNSPOT ROMINENCES. L.Marshall.
strophys. J., Vol. 126, No. 1, 177-84 (July, 1957).

An explanation is proposed for condensations and coronal reaming phenomena in sunspot prominences as seen in Hα light. emperatures and pressures in looped solar prominences are such that small changes in kinetic temperature cause large changes in the density of H atoms and therefore in the intensity of Hα light emitted. It is proposed that small changes in magnetic fields of looped prominences produce these temperature changes by induction acceleration. If, for example, the kinetic temperature of a prominence suddenly changes from 12 000° to 8000°, solar coronagraph cine pictures will show the previously dark prominence suddenly developing a glowing cloud. Coronal streaming phenomena and surges thus, according to this model,are symptoms of sunspot changes and may be analyzed to obtain information on behaviour of magnetic fields in sunspot groups. A.

523.755 : 523.164.3

4660. ON THE INVESTIGATION OF THE SOLAR SUPERCORONA BY THE RECEPTION OF RADIO EMISSION FROM JUPITER. V.V.Vitkevich.
Astron. Zh., Vol. 34, No. 2, 217-221 (1957). In Russian.

It is suggested that the radiowaves emitted by Jupiter, which pass through the solar supercorona, may be used to investigate the properties of the latter. The intensity of this radiation is a maximum at 12-15 m, and the size of the radiating area is very small (less than 1'). A radio-interferometer is described which makes it possible to separate out the effects of sunspots. It is emphasized that a study of the supercorona by this method, during years of both maximum and minimum solar activity, will lead to information on the dependence of the latter on the phase of the solar cycle and its physical nature. S.Chomet

523.755

4661. THE DISTRIBUTION OF MATTER IN POLAR RAYS OF THE SOLAR CORONA. N.I.Dzyubenko.
Astron. Zh., Vol. 34, No. 3, 379-90 (1957). In Russian.

A photometric investigation of 9 polar rays in the solar corona is reported. The electron density in a polar ray may be represented by a formula of the form $N_e = N_0 r^{-n}$, where r is the distance from the centre of the sun and $6 < n < 11$. The results obtained support the hypothesis that a general magnetic field exists on the sun's surface and extends to considerable heights above it. All transport phenomena (diffusion, thermal conductivity, etc.) in a sufficiently rarified ionized medium take place mainly in the direction of the magnetic lines of force. Attempts to represent the polar rays as streams of particles rapidly receding from the sun meet with difficulties. The hypothesis of diffusion of plasma along the lines of force of the solar magnetic field is more acceptable. S.Chomet

523.755 : 523.164.32

4662. A MODEL OF THE INNER CORONA BASED ON RADIO DATA. B.N.Panovkin.
Astron. Zh.,Vol. 34, No. 4, 505-15 (1957). In Russian.

It has recently been shown that the radio brightness maximum does not coincide with the solar limb in the decimeter range, but is displaced towards the centre of the sun. The displacement increases with wavelength and cannot be explained by a simple isothermic model of the corona. A new model, including a temperature gradient, is proposed. It is shown that this model can explain observational data. S.Chomet

523.77

4663. FORMATION OF ABSORPTION LINES IN A SUNSPOT. J.W.Warwick.
Ann. Astrophys., Vol. 20, No. 4, 165-74 (1957).

After pointing out the importance of a satisfactory theory of line formation in sunspots, two alternative sets of transfer equations are devised, one in terms of a new set of intensity parameters which lead to a symmetric formulation, and the other in terms of Stokes' parameters. For a simple, but important, choice of the source function, formal solutions to the symmetric transfer equations are derived. A.

523.77

4664. PRELIMINARY OBSERVATIONS WITH A 9 METRE SOLAR SPECTROGRAPH. G.Laborde, R.Michard and R.Servajean.
Ann. Astrophys., Vol. 20, No. 6, 209-21 (1957). In French.

A new solar spectrograph, in operation at Meudon since summer 1956, is described. Its plane 180 mm grating can be used with good efficiency both in low orders on one side of the normal, and in high orders on the other side. The spectrograph performance is discussed. In 1956 observations with the new instrument were chiefly of an exploratory character, with a view to ascertain its possibilities and to devise suitable techniques for the study of the following questions: spectrophotometry of sunspots, detailed measurements of sunspot magnetic fields, local Doppler shifts associated with

sunspots and the photospheric or chromospheric structure. These problems are briefly discussed and some qualitative results are given, particularly on the variation with height of the Hα profile from single chromospheric spicules. A.

523.77

4665. PROFILE OF THE YELLOW CORONAL LINE, λ 5694. D.E.Billings.
Astrophys. J., Vol. 125, No. 3, 817-21 (May, 1957).

Three yellow coronal lines appearing on 2.5 A/mm spectrograms show almost identical profiles. The half-width of these profiles corresponds to temperatures of approximately 4 000 000°, assuming that the emitting ion is Ca XV. A measurement of the yellow-line brightness and the continuum brightness at the point of yellow-line emission indicates that the electron density is about 2×10^{10} per cm^3 and that about 4% of the Ca ions are in the upper excitation level of Ca XV for the 5694 A emission. Profiles of 5303 A at points of yellow-line emission show broad wings, indicating that part of the Fe XIV emission from along the line of sight comes from a very high-temperature region. A.

523.77

4666. A SPECTROSCOPIC INVESTIGATION OF THE DEUTERIUM D_α-LINE IN ACTIVE REGIONS ON THE SUN. A.B.Severnyĭ.
Astron. Zh., Vol. 34, No. 3, 328-35 (1957). In Russian.

The 6561.105 A line was studied for 28 active areas on the sun. It is shown that there is another line close to it, and that the wavelength of this new line is 6561.09 A. It is suggested that the latter line is due to the presence of deuterium on the sun (relative abundance D/H up to 10^{-4}). S.Chomet

523.77

4667. A PHOTOGRAPHIC INVESTIGATION OF THE ENERGY DISTRIBUTION IN THE CONTINUOUS SOLAR SPECTRUM IN ABSOLUTE UNITS. E.A.Makarova.
Astron. Zh., Vol. 34, No. 4, 539-56 (1957). In Russian.

The distribution is determined in the region 3700-8000 A by comparison with the spectrum of a standard lamp and is in agreement with the results of Wilsing (1913, 1917). There is an anomaly in the region 4400-5600 A and a subsidiary maximum in the region 6800-7400 A. S.Chomet

523.77

4668. LYMAN ALPHA AND X-RAY EMISSIONS DURING A SMALL SOLAR FLARE.
T.A.Chubb, H.Friedman, R.W.Kreplin and J.E.Kupperian, Jr.
J. geophys. Res., Vol. 62, No. 3, 389-98 (Sept., 1957).

A rocket, with equipment to measure Lyman alpha and X-rays, was fired while a small flare was in progress on 20 June 1956. The rocket reached peak altitude about 10 min after the flare was first seen visually. An unusually high X-ray flux was observed, extending to a short wavelength limit of 3 A. Although the flare was still visible in Hα, Lyman alpha was not appreciably different from normal. A.

523.77

4669. THE INFLUENCE OF THE SPECTROGRAPHIC INSTRUMENT ON INTENSITY MEASUREMENTS OF SPECTRAL LINES. H.K.Paetzold and H.Zschörner.
S.B. Heidelberg. Akad. Wiss. (math. nat. Kl.), 1956-57, No. 4, 394-403. In German.

A critical discussion of the effect of the apparatus function on profiles, and central intensities of solar absorption lines, with application to the evaluation of O_3 temperatures from line intensity measures in the Huggins band. D.R.Barber

523.774 : 535.338.334

4670. CALCULATION OF THE EQUIVALENT WIDTH OF BALMER LINES. C.Pecker.
Ann. Astrophys., Vol. 20, No. 5, 196-206 (1957). In French.

The author tabulated the saturation functions needed for a theoretical calculation of the equivalent width of a hydrogen line in the case of Stark broadening and Stark plus Doppler broadening. These calculations were then used to construct a theoretical curve of growth of the photospheric Balmer lines. This curve was compared with the experimental curve of growth of de Jager and the position of the continuous background near the Balmer discontinuity was determined. A.

523.775

4671. ON THE ENHANCEMENT OF CERTAIN HELIUM LINES IN THE LIMB FLARE OF JUNE 24, 1956. H.Zirin.
Astrophys. J., Vol. 126, No. 1, 159-66 (July, 1957).

An unusually well-observed limb flare occurred on June 24, 195 The lines 4471, 4713, 4922, and 6678 of neutral helium, 4686 of ionized helium, and Hα and Hβ appear strongly in the spectra. The intensities of 4471, 4686, 4713, and 4922 are about equal. The temperature of the flare is deduced by comparing the Doppler half-width of the helium and hydrogen lines and, more accurately, from the relative intensities of 4686 and 4471. Both methods give roughly 30 000°. The anomalous excitation of 4713 and 4922 are studied in terms of the helium equilibrium. It is found that at high temperatur and densities these lines, as well as certain other helium lines, are strongly excited relative to 4471 and 5876 by collisions from the 1^1S ground state of helium. The conditions necessary are $T_e > 30\,000$ and $N_e > 3 \times 10^{12}$. A.

523.812

4672. ON THE DISTRIBUTION OF VISIBLE STARS. A.Ramakrishnan and R.Vasudevan.
Astrophys. J., Vol. 126, No. 3, 573-8 (Nov., 1957).

The distribution function of the number of visible stars per unit solid angle in the line-of-sight was obtained by Chandrasekhar and Münch, on the assumption that the random elements in the problem consisted of the intrinsic intensities of the stars and the absorption by the interstellar clouds. In the present paper an additional random element is introduced into the spatial distribution of stars, and the results are compared with those of Chandrasekhar and Münch. A.

523.83

4673. ON THE APPLICATION OF THE VIRIAL THEOREM IN THE DYNAMICS OF STELLAR SYSTEMS. A.M.Mikisha and F.A.Tsitsin.
Astron. Zh., Vol. 34, No. 4, 678-80 (1957). In Russian.

A new formulation of the virial theorem is given. This is stated to be more general than that used hitherto. It is shown that the relation $2T + \Omega = 0$ may apply to some non-stationary stellar systems (T is the kinetic energy, Ω the potential energy). S.Chomet

523.84

4674. STUDIES OF THE WHITE DWARFS. I. BROAD FEATURES IN WHITE DWARF SPECTRA. J.L.Greenstein and M.S.Matthews.
Astrophys. J., Vol. 126, No. 1, 14-18 (July, 1957).

The method for measuring broad, shallow features in white dwarf spectra is described. Unidentified bands in AC + 70°8247, W 219, and L 879-14 are illustrated. Broad, very shallow lines of He I are found in HZ 29, a probable white dwarf. A.

523.84

4675. STUDIES OF THE WHITE DWARFS. II. SOME NEW WHITE DWARFS. J.L.Greenstein and W.J.Luyten.
Astrophys. J., Vol. 126, No. 1, 19-22 (July, 1957).

Five new white dwarfs discovered in the course of the Bruce proper-motion survey were observed and confirmed spectroscopically. Three are of the normal DA type, and two others have peculiar spectra. Finding charts are given for the new objects, as well as for L 817-13 and L 1573-31 (previously announced), for which no charts exist. A.

523.84

4676. STUDIES OF THE WHITE DWARFS. III. THE RECURRENT NOVA WZ SGE AS A PROBABLE WHITE DWARF. J.L.Greenstein.
Astrophys. J., Vol. 126, No. 1, 23-7 (July, 1957).

Spectra of the recurrent nova, WZ Sge (1913, 1946), show that, in addition to emission lines, the blue continuous spectrum has broad hydrogen absorption lines. The strength and profiles of these lines resemble those in normal white dwarfs, and the luminosity of WZ Sge is in the white dwarf range. The possible relation between certain old novae and white dwarfs is discussed. A.

523.852.22

4677. THE RATIO OF HELIUM AND HYDROGEN ABUNDANCES IN PLANETARY NEBULAE. J.S.Mathis.
Astrophys. J., Vol. 126, No. 3, 493-502 (Nov., 1957).

In the first part of the paper the populations of seventeen of the lowest singlet terms of neutral helium are found by an approximate theory of statistical equilibrium. The 2^1S term is assumed to be insufficiently metastable to affect the populations of the terms above it, and transitions to the ground state are assumed to be balanced by

he inverse transitions. The effects of variations in electron temperature and density along the line of sight in the nebula are next discussed. The error introduced by such fluctuations into the ratio of helium and hydrogen abundances is found to be probably less than 10%. The abundance ratios N_{He}/N_H for several nebulae are discussed. Except for NGC 6572, the photometric data are taken from previous publications. The derived abundances are not found to depend upon the nebular excitation. Probably these are intrinsic abundance differences in planetaries. The mean ratio of hydrogen to helium is 5.4. The ratio found previously for the Orion Nebula showed slightly less helium but was within the spread of values obtained for the planetaries. A.

523.852.24

678. THE CRAB NEBULA AND THE ORIGIN OF INTERSTELLAR MAGNETIC FIELDS. J.H.Piddington.
Australian J. Phys., Vol. 10, No. 4, 530-46 (Dec., 1957).

Electromagnetic effects in the Crab nebula were investigated with the following conclusions. (1) No appreciable proportion of the present central magnetic field could have passed in or out through the surrounding ionized supernova shell during its 900 years life. (2) A limitation of the generality of the virial theorem of Chandrasekhar and Fermi (Abstr. 33/1954) is mentioned and some consequences: the upper limit of magnetic field strength in a star must, in general, be reduced below their estimate. The theorem does not appear relevant and should not be used in the case of fields which fall off slowly beyond the photospheric surface. Force-free fields seem improbable in nature, particularly in relation to the Crab nebula. (3) The nebular magnetic field was not formed from the general interstellar field, nor by turbulence in the supernova shell, nor was it in existence at the time of the explosion. (4) The main field has been created during the expansion as complete loops of magnetic force, within the shell but linking neither the shell nor the central star. The average rate of generation of magnetic energy is some 10^4 times the total output of solar energy and must derive more or less directly from nuclear energy. (5) A significant part of the galactic magnetic field may have originated inside supernova shells. (6) The mass of the expanding supernova shell is probably about one solar mass. (7) Irregular motions seen in the nebula are hydromagnetic waves causing a compression of the magnetic field with consequently enchanced light emission. (8) The cosmic rays in the nebula are accelerated by hydromagnetic waves according to the process of statistical acceleration. A significant fraction of all galactic cosmic rays may originate in this way; not with the supernova explosion itself but subsequently within the space between the star and the shell. (9) The nebular magnetic field may be generated by the central star spinning, the energy and angular momentum being supplied by fast particles ejected from the star. A somehwat similar process may be responsible for stellar and other cosmic magnetic fields. A.

523.872

679. EIGHTH INTERNATIONAL ASTROPHYSICAL COLLOQUIUM ON "STARS WITH EMISSION LINES".
Mem. Soc. Roy. Sci. Liège, Vol. 20, 518 pp. (1958). In French.

This was organized by the Astrophysical Institute of the University of Liège, and held there in the summer of 1957. A detailed study of the spectra of the extensive group of bright-line stars is fundamental to the proper understanding of the complex physical processes at work in stellar atmospheres: this is emphasized, and reflected in the scope and content of the 57 papers presented at the colloquium. Much recent observational material is included in the four main sections: (1) the hot bright-line stars; (2) the intermediate temperature bright-line stars; (3) the cool bright-line stars; and (4) the peculiar stars. Section (1) includes a detailed discussion of the important Wolf—Rayet stars; (2) contains a reference to a bright U-V T Tauri star, for which the u.v. continuum at 3500 A is found to be 33% polarized, the polarized component being presumably due to radiation from fast particles accelerated by the stellar magnetic field; (3) includes a description of a novel application of electrical discharge theory to explain the excitation mechanism in the atmospheres of the long-period variable stars; and (4) contains a report of recent spectrographic observations of H emission in the spectrum of Algol (β Persei). Two additional sections, (5) and (6), deal with the relationships existing between the various types of stars with emission spectra; and with recent theoretical and experimental investigations of forbidden emission lines, and bands of astrophysical interest.

D.R.Barber

523.872

4680. ABSOLUTE SPECTROPHOTOMETRY IN ASTRONOMICAL RESEARCH. (THE PROBLEM OF STELLAR TEMPERATURES). H.Kienle.
S.B. Heidelberg. Akad. Wiss. (math. nat. Kl.), 1956-57, No. 4, 362-70. In German.

A brief survey covering the application of classical radiation theory to the evaluation of stellar colour temperatures, with a reference to the various standard light-sources available for spectral comparison with the light of the stars. D.R.Barber

523.872

4681. THE INFLUENCE OF SPECTRAL RESOLUTION ON THE APPARENT DISTRIBUTION OF INTENSITY IN THE CONTINUOUS SPECTRUM. J.Wempe.
S.B. Heidelberg. Akad. Wiss. (math. nat. Kl.), 1956-57, No. 4, 390-3. In German.

A discussion (with examples) of the effects of unresolved and blended absorption, and emission lines in masking the true continuum in stellar spectra. D.R.Barber

523.873

4682. THE EVOLUTION OF EARLY MAIN-SEQUENCE STARS. R.S.Kushwaha.
Astrophys. J., Vol. 125, No. 1, 242-59 (Jan., 1957).

The early phases of evolution for three early main-sequence stars with masses 10, 5, and 2.5 times the solar mass are considered. The range of spectral types covered is from B1 to A2. Radiation pressure is taken into account. Opacity is computed by straight addition of electron scattering and Kramers absorption with modified guillotine factor. The initial homogeneous models for these stars are constructed, and their evolution is followed. It is found that the convective core retreats, creating an inhomogeneous radiative zone between itself and the outer homogeneous radiative envelope. During the early evolutionary phases all the nuclear energy is generated inside the core. These early evolutionary phases are represented here by a series of three or four inhomogeneous models for each of the three stars. For the heaviest mass two later inhomogeneous models models are also computed, in which the energy generation in the intermediate zone is accounted for. It is seen that the HR diagram constructed from these models agrees well with the observed one for galactic clusters. The theoretical models are also checked by computing the apsidal-motion constants for the three initial models, as well as for some of the later models. Quite reasonable agreement is found with observations. A.

523.877

4683. AXIALLY SYMMETRIC TORSIONAL OSCILLATIONS OF A STAR IN THE PRESENCE OF A POLOIDAL MAGNETIC FIELD. C.Plumpton.
Astrophys. J., Vol. 125, No. 2, 494-9 (March, 1957).

Torsional oscillations of a non-rotating star of infinite conductivity in the presence of a permanent, axially symmetric poloidal magnetic field are considered. An approximate solution of the field equations is derived. The toroidal field is shown to be propagated along the lines of permanent magnetic force. The dependence of the amplitude of the oscillations on the density is discussed, and the bearing of the solution on the origin of sunspots is examined. The effect of the second-order terms is discussed qualitatively. A.

523.877

4684. THE AVERAGE PHYSICAL PROPERTIES AND SPECTRA OF STELLAR ATMOSPHERES AS A FUNCTION OF THEIR HYDROGEN AND HELIUM CONTENT. A.Unsöld.
Nachr. Akad. Wiss. Göttingen, math.-phys. Kl. IIa, 1958, No. 2, 49-58. In German.

Calculations are made about the changes of the physical parameters and the "effective numbers" of spectroscopically important atoms in a stellar atmosphere, if, for given mean values of the temperature and the electron pressure, the abundance ratios of hydrogen, helium, and heavy elements (metals) are changed. Low abundances of metals (relative to hydrogen) cause a weakening of the metallic lines as long as free electrons originate predominantly from the ionization of hydrogen, i.e. for high and average temperatures. However, for cooler stars free electrons originate from metals, and then a decrease in the abundance of metals has only a very small spectroscopic effect. A.Beer

523.877

4685. STRUCTURE OF THE VISUAL CONTINUOUS SPECTRUM. D.Chalonge.
S.B. Heidelberg. Akad. Wiss. (math. nat. Kl.), 1956-57, No. 4, 404-7. In French.

The two parameters, Φ_b, (gradient at $1/\lambda = 2.15$), and δ_λ (obs. difference between the intensity in the continuous spectrum of a star, and that of a black-body corresponding to the stellar gradient, Φ, at $1/\lambda = 1.9$) yield a new criterion for differentiating between normal type dwarf stars, the metallic line stars, and the sub-dwarfs. D.R.Barber

525.3

4686. ORBITAL BEHAVIOR OF EARTH SATELLITES. I. R.E.Roberson.
J. Franklin Inst., Vol. 264, No. 3, 181-202 (Sept., 1957).

Recent treatments of the effect of the oblateness of the earth are reviewed. A number of orbital results of value in satellite engineering are presented, and some of the perturbation sources on a satellite orbit discussed. A solution is developed of first order in the oblateness for orbits about an oblate spheroid by a method similar to Hansen's classical perturbation method. Particular attention is given to the effect of initial conditions on the orbit elements. A.

525.3

4687. ORBITAL BEHAVIOUR OF EARTH SATELLITES. II. R.E.Roberson.
J. Franklin Inst., Vol. 264, No. 4, 269-85 (Oct., 1957).

See preceding abstract.

525.3

4688. ATMOSPHERIC DRAG ON THE SATELLITE. R.Jastrow and C.A.Pearse.
J. geophys. Res., Vol. 62, No. 3, 413-23 (Sept., 1957).

The drag exerted on the satellite in its orbit arises partly from collisions with neutral air particles and partly from losses associated with the passage of a charged sphere through an ionized medium. It is found that the charged and neutral effects are comparable under the atmospheric conditions expected at an orbital altitude of 300 miles. A.

525.3 : 531.57 : 623.451.8

4689. SOME VARIATIONAL PROBLEMS ASSOCIATED WITH THE LAUNCHING OF AN ARTIFICIAL EARTH SATELLITE. D.E.Okhotsimskiĭ and T.M.Éneev.
Uspekhi fiz. Nauk, Vol. 63, No. 1a, 5-32 (1957). In Russian.

The paper is concerned with the problem of getting a satellite into its orbit, and in particular with the law of variation with time of the thrust direction of the rocket motor, in order to place the satellite in its orbit with the minimum consumption of fuel. Also discussed is the optimum programme for a multistage rocket, assuming a given fuel expenditure. The problem is generalized of getting a satellite into its orbit for the case of motion in a central gravitational field, taking account of the earth's rotation. C.R.S.Manders

525.3

4690. DETERMINATION OF THE LIFETIME OF AN ARTIFICIAL EARTH SATELLITE AND A STUDY OF THE SECULAR PERTURBATIONS OF ITS ORBIT. D.E.Okhotsimskiĭ, T.M.Éneev and G.P.Taratynova.
Uspekhi fiz. Nauk, Vol. 63, No. 1a, 33-50 (1957). In Russian.

The existence is shown of universal relationships between the basic parameters of the oscilating ellipse and the heights of the perigee and apogee, and also between the parameters and the eccentricity. These relations are true for any satellite and depend only upon the law of distribution of the air density with height. C.R.S.Manders

525.3

4691. THE MOTION OF AN ARTIFICIAL SATELLITE IN A NON-CENTRAL TERRESTRIAL GRAVITATIONAL FIELD WITH ATMOSPHERIC RESISTANCE. G.P.Taratynova.
Uspekhi fiz. Nauk, Vol. 63, No. 1a, 51-8 (1957). In Russian.

The methods are given for calculating, on a high-speed machine, the motion of an artificial earth satellite, taking account simultaneously of atmospheric resistance, motion of the atmosphere relative to the earth, and deviations of the gravitational field. The perturbing effect of sun and moon on the motion of the satellite with respect to the earth is shown to be negligible. C.R.S.Manders

525.3 : 523.3 : 531.55

4692. SOME PROBLEMS OF THE DYNAMICS OF FLIGHT TO THE MOON. V.A.Egorov.
Uspekhi fiz. Nauk, Vol. 63, No. 1a, 73-117 (1957). In Russian.

The equations of motion are discussed and the theoretical solutions given for the problem of minimal velocities. The numerical methods of determining the trajectories, and the minimal velocity are given, together with an analysis of the approach trajectory and the problem of landing on the moon. Flight past the moon and periodic flight past the moon are dealt with. C.R.S.Manders

525.3 : 530.12

4693. THE USE OF ARTIFICIAL EARTH SATELLITES FOR VERIFYING THE GENERAL THEORY OF RELATIVITY. V.L.Ginzburg.
Uspekhi fiz. Nauk, Vol. 63, No. 1a, 119-22 (1957). In Russian.

From the general theory of relativity it follows that the perihelia of planets revolve slowly, that light rays are deviated on passing near the sun, and that there is gravitational displacement of spectrum lines. Taking likely data it is shown that a satellite offers a prospect of verifying the general theory of relativity in respect of these effects, as well as in other directions. C.R.S.Manders

PHYSICS

53

4694. REPORTS FROM THE CONFERENCE OF THE SWEDISH NATIONAL COMMITTEE FOR PHYSICS IN 1957. G.Borelius and E.Rudberg.
Ark. Fys., Vol. 13, Paper 23, 251-96 (1958).

Contains abstracts of papers presented at 9th General Physics Conferences of the Swedish National Committee for Physics held in June 1957 at Uppsala.

53.081.6 : 539.12

NOTE ON THE MEASUREMENT OF E/M BY THE HOAG METHOD. See Abstr. 4218

53.088.21

4695. A METHOD OF DETECTING AN OBSERVER BIAS. R.M.Tennent.
Phil. Mag. (Eighth Ser.), Vol. 3, 776-9 (July, 1958).

In a series of observations of "x, not-x" type, the distribution of runs of one, two, three .... x's may be used as a criterion to test for randomness. This paper investigates, with numerical examples, the distribution to be expected when the series is of simple Markoff type i.e. the probability of observing an x depends only on whether the immediately preceding observation was "x" or "not-x". The formulae (1) and (2) of the paper apply to series of infinite length only, although for series of moderate length, and short runs, the approximation should be good. N.L.Johnson

FUNDAMENTALS

530.12

4696. PHYSICAL PROPERTIES OF SOME EMPTY SPACE–TIMES. V.Joseph.
Proc. Cambridge Phil. Soc., Vol. 53, Pt 4, 836-42 (Sept., 1957).

The canonical form of the Riemann tensor is found for certain non-flat empty space–times. Some invariant physical properties of these space–times are investigated. The status of Mach's principle in general relativity theory is briefly discussed in the light of these examples. A.

530.12

4697. GENERAL SOLUTION OF THE EQUATIONS $g_{\mu\nu;\rho} = 0$. EXPRESSION OF THE AFFINE CONNECTION AS A FUNCTION OF THE NON-DISSOCIATED FUNDAMENTAL TENSOR $g_{\mu\nu}$. M.A.Tonnelat.
C.R. Acad. Sci. (Paris), Vol. 246, No. 15, 2227-30 (April 14, 1958). In French.

The affine connection in Einstein's unified theory is expressed in terms of generalized Christoffel symbols defined for the tensor $g_{\mu\nu}$. Previous solutions have involved the decomposition of $g_{\mu\nu}$ into symmetric and skew parts. R.A.Newing

530.12

4698. THE FOUNDATIONS OF A GENERALIZATION OF GRAVITATION THEORY. J.Moffat.
Proc. Cambridge Phil. Soc., Vol. 53, Pt 2, 473-88 (April, 1957).

A unified theory of gravitation and electromagnetism is constructed from a geometry based on a complex symmetric tensor $g_{\mu\nu}$. A set of field equations is uniquely determined by the choice of a real Hamiltonian world function. It is claimed that the Lorentz force follows from the field equations by using the Einstein, Infeld and Hoffmann approximation method. G.Stephenson

530.12

4699. ON A NON-SYMMETRIC THEORY OF THE PURE GRAVITATIONAL FIELD. D.W.Sciama.
Proc. Cambridge Phil. Soc., Vol. 54, Pt 1, 72-80 (Jan., 1958).

It is suggested, on heuristic grounds, that the energy—momentum tensor of a material field with non-zero spin and non-zero rest-mass should be non-symmetric. The usual relationship between energy—momentum tensor and gravitational potential then implies that the latter should also be a non-symmetric tensor. This suggestion has nothing to do with unified field theory; it is concerned with the pure gravitational field. A theory of gravitation based on a non-symmetric potential is developed. Field equations are derived, and a study is made of Rosenfeld identities, Bianchi identities, angular momentum and the equations of motion of test particles. These latter equations represent the geodesics of a Riemannian space whose contravariant metric tensor is g^{ij}, in agreement with a result of Lichnerowicz (1954) on the bicharacteristics of the Einstein—Schrödinger field equations. A.

530.12

4700. CONTRIBUTION TO THE PROJECTIVE THEORY OF RELATIVITY. E.Schmutzer.
Z. Phys., Vol. 149, No. 3, 329-39 (1957). In German.

A generalized geometry is developed by relaxing the requirement that the vector basis in five-space shall form an exact differential. Gravitational and electromagnetic fields are interpreted in terms of the new theory, and the divergences of the new representation from Jordan's theory are discussed. R.A.Newing

530.12 : 530.145

4701. SPINOR FIELDS IN GENERAL RELATIVITY. H.S.Green.
Proc. Roy. Soc. A, Vol. 245, No. 1243, 521-35 (1958).

A unitary field theory is developed with two fundamental field variables, a spinor and a bispinor-vector (set of Dirac matrices). The theory is required to be invariant under general coordinate transformations and similarity (spinor) transformations, and it is shown, under a minimum of restrictive hypotheses, that Einstein's concept of teleparallelism is implied. Dirac's equation is formulated in this unitary theory, and the electromagnetic field potentials are identified. An action density is proposed for the field which appears to exhibit gravitational and electromagnetic field properties consistent with experiment. There are indications that the charge of the elementary particles is quantized. Most of the paper is devoted to a specialization in which the "natural" derivative of the Dirac matrices is made to vanish. The generalization of this theory is briefly considered at the end, and is found to introduce other fields, including a pseudo-scalar field which may account for nuclear forces. A.

530.12

4702. ENERGY AND MOMENTUM OF CYLINDRICAL GRAVITATIONAL WAVES. N.Rosen.
Phys. Rev., Vol. 110, No. 1, 291-2 (April 1, 1958).

By carrying out the calculation in a Cartesian coordinate system rather than in a cylindrical polar system (see Abstr. 6838/1957), the energy and momentum densities of cylindrical gravitational waves are found to be finite and physically meaningful quantities. G.Stephenson

530.12 : 531.51

4703. GRAVITATIONAL WAVES IN GENERAL RELATIVITY. II. THE REFLEXION OF CYLINDRICAL WAVES. L.Marder.
Proc. Roy. Soc. A, Vol. 246, No. 1244, 133-43 (1958).

For Pt I, see Abstr. 3676 (1958). The reflection of outward travelling cylindrical gravitational waves by a thin cylindrical shell of matter is discussed. The shell is regarded as a surface distribution, and it is shown that if it is perfectly rigid, total reflection occurs. Quasi-periodic incident waves are found to lead to a completely periodic standing wave state between the reflector and a central wave-source, the field outside the system remaining static. In the treatment of standing waves the components of the stress—energy tensor in the shell are determined and the construction for a model source is given. A.

530.12 : 525.3

THE USE OF ARTIFICIAL EARTH SATELLITES FOR VERIFYING THE GENERAL THEORY OF RELATIVITY. See Abstr. 4693

530.12

4704. THE RESOLUTION OF THE CLOCK PARADOX. G.Builder.
Austral. J. Phys., Vol. 10, No. 2, 246-62 (June, 1957).

It is shown that the so-called "clock paradox" can be resolved completely in terms of the restricted theory of relativity. Properly applied, the theory gives a unique and unambiguous value for the relative retardation of two clocks. The seeming paradox can, and does, arise only through using the "rate" of a moving clock without due regard to the exact significance of the quantity so described. The usual hypothetical experiment, in which an observer M travels away from, and returns to, an observer R, with constant speed in a straight line, is described in terms of an accelerated reference system in which M remains at rest at the origin; but it is shown that such a description cannot be regarded as the account that would be given by M of the experiment. The principle of equivalence is completely irrelevant to analysis and discussion of the relative retardation of clocks unless there is a real gravitational field to be taken into account and, except in such a case, the general theory of relativity can add nothing of physical significance to an analysis correctly made using the restricted theory. A.

530.12

4705. A SUGGESTED EXPERIMENT ON THE CLOCK PARADOX. W.Cochran.
Proc. Cambridge Phil. Soc., Vol. 53, Pt 3, 646-50 (July, 1957).

An experiment is suggested to settle the question whether two clocks which are synchronized and subsequently separated must necessarily show identical readings on being brought together again. Charged π-mesons play the role of a clock travelling with a velocity comparable with c, this clock being read by passing the mesons through a scintillation counter or counters. It is pointed out that the experiment can be designed in a way which makes it technically feasible for a laboratory possessing an accelerating machine capable of producing mesons in the 100 MeV energy range. Some considerations suggested by the proposed experiment are examined, and it is concluded that only the orthodox result — that in general the two clocks will record the passage of different time intervals between successive coincidences — is consistent with the result of an experiment which has already been made, or with the special theory of relativity. A.

530.145

4706. THE INTERPRETATION OF QUANTUM MECHANICS. A.Datzeff.
C.R. Acad. Sci. (Paris), Vol. 246, No. 10, 1502-5 (March 10, 1958). In French.

The paper seeks to obtain a causal interpretation of wave mechanics by assuming that the aether is composed of particles capable of forming aggregates having quantized energies. Their interaction with small material particles, such as electrons, gives the latter a complex motion, analogous to the Brownian movement. In macroscopic objects the motion is not perceptible and classical mechanics is valid. P.M.Davidson

530.145

4707. THE PROBABILITY OF PRESENCE IN QUANTUM MECHANICS. A.Datzeff.
C.R. Acad. Sci. (Paris), Vol. 246, No. 11, 1670-2 (March 17, 1958). In French.

An extension of the ideas proposed in a previous paper (see preceding abstract). By means of certain hypotheses the Schrödinger wave equation is obtained. P.M.Davidson

530.145

4708. THE MATHEMATICAL FORMALISM OF QUANTUM MECHANICS. A.Datzeff.
C.R. Acad. Sci. (Paris), Vol. 246, No. 12, 1812-15 (March 24, 1958). In French.

A further discussion of the ideas proposed in previous papers (see preceding abstract). Formulae for the momentum and other physical quantities are obtained, in agreement with the Schrödinger theory. P.M.Davidson

530.145

4709. A GROUP-THEORETICAL CONSIDERATION OF THE FIRST PRINCIPLES OF RELATIVISTIC QUANTUM MECHANICS. I. THE GENERAL PROPERTIES OF THE INHOMOGENEOUS LORENTZ GROUP. Yu.M.Shirokov.
Zh. éksper. teor. Fiz., Vol. 33, No. 4(10), 861-72 (1957). In Russian.

This paper begins a series of articles devoted to a group-theoretical investigation of the possibilities of relativistic quantum mechanics, not based on any concrete form of equations of motion. In the present paper an examination is made of certain general properties of group representations as well as of a number of the specific properties of the representations of an inhomogeneous Lorentz group. A.

530.145

4710. A GROUP-THEORETICAL CONSIDERATION OF THE FIRST PRINCIPLES OF RELATIVISTIC QUANTUM MECHANICS. II. A CLASSIFICATION OF IRREDUCIBLE REPRESENTATIONS OF AN INHOMOGENEOUS LORENTZ GROUP. Yu.M.Shirokov.
Zh. éksper. teor. Fiz., Vol. 33, No. 5(11), 1196-207 (1957). In Russian.

A classification of the states of a relativistic quantum system is given. Irreducible representations of an inhomogeneous Lorentz group are divided into four basic classes P_m, P_Π, P_0, O_0. All representations of classes P_m, P_Π, both unitary and non-unitary, are obtained in the explicit form. A.

530.145

4711. A GROUP-THEORETICAL CONSIDERATION OF THE FIRST PRINCIPLES OF RELATIVISTIC QUANTUM MECHANICS. III. IRREDUCIBLE REPRESENTATIONS OF CLASSES P_0 AND O_0 AND NOT FULLY REDUCIBLE REPRESENTATIONS OF AN INHOMOGENEOUS LORENTZ GROUP. Yu.M.Shirokov.
Zh. éksper. teor. Fiz., Vol. 33, No. 5(11), 1208-14 (1957). In Russian.

All unitary and non-unitary irreducible representations of class P_0 of an inhomogeneous Lorentz group are obtained in the explicit form. The isomorphism of representations of class O_0 and representations of a homogeneous Lorentz group is considered. Certain not fully reducible representations of an inhomogeneous Lorentz group that are of physical interest are indicated. A.

530.145

4712. A NOTE ON STATISTICAL TENSORS IN QUANTUM MECHANICS. L.C.Biedenharn.
Ann. Phys. (New York), Vol. 4, No. 1, 104-13 (May, 1958).

The statistical tensors introduced by Fano are discussed as an operator form of the density matrix. The conditions for a statistical tensor to represent a pure state are derived; a general representation of a pure state in terms of 2j Poincaré vectors is exhibited, and a physical interpretation given. The coupling of statistical tensors is discussed briefly. A.

530.145

4713. THE REPRESENTATION OF THE SIMILITUDES OF SPACE BY MEANS OF SPINORS. M.Morand.
C.R. Acad. Sci. (Paris), Vol. 245, No. 23, 2028-31 (Dec. 4, 1957). In French.

Study of the similitudes of ordinary three-dimensional space and of the space of pairs of orthogonal vectors of same length and same origin. The similitude operation is represented by means of spinors. [Essentially, their length is the ratio of similitude]. J.Lascoux

530.145 : 539.12 : 539.165.2

4714. CONSERVATION LAWS FOR LEPTON PROCESSES. M.Konuma, S.Nakamura and H.Umezawa.
Phys. Rev., Vol. 109, No. 4, 1404-6 (Feb. 15, 1958).

The restrictions imposed by the requirement of invariance under generalized gauge transformations, which lead to the conservation laws for lepton number and neutrino charge, are considered for the most general neutrino interactions in β-decay and μ-decay. It is found that they are incompatible with: (1) the twin-neutrino theory, (2) the same helicity for the neutrino, but different interactions, in negatron and positron decays. However, they permit the following standpoint: a negatron (positron) is emitted together with a left-(right)-handed neutrino by the (S, T, P) interactions only. [This last standpoint is taken by Feynman and Gell-Mann (Abstr. 507/1958), but using the (V,A) interaction instead of (S,P,T)]. J.Lascoux

530.145

4715. COMMUTATION RELATION OF DIFFERENT FIELDS AND THE TCP THEOREM. T.Kinoshita.
Phys. Rev., Vol. 110, No. 4, 978-81 (May 15, 1958).

In proving the TCP theorem, it is customary to assume, besides other assumptions, that kinematically independent fermion fields anticommute with each other and boson—boson and boson—fermion pairs satisfy ordinary commutation relations. In this paper, it is shown in an elementary fashion that this assumption is actually not necessary to prove the invariance of field theory under TCP. A.

530.145 : 539.17

4716. THE TIME REVERSAL AND REACTIONS INVOLVING POLARIZED PARTICLES. M.I.Shirokov.
Zh. éksper. teor. Fiz., Vol. 33, No. 4(10), 975-81 (1957). In Russian.

If the interaction between the particles in the reactions $a + b \rightleftharpoons c + d$ is invariant under the time reversal, it is possible to obtain certain relations connecting the angular distribution, polarization vectors and tensors of the particles a, b, c, d in the direct and inverse reactions (the spins of the particles being arbitrary). These relations can be considered as the generalization of the "detailed balance" principle. A.

530.145 : 539.12

4717. PARITY NON-CONSERVATION IN NEUTRINO INTERACTIONS AND THE $\tau-\theta$ PROBLEM. R.Gatto.
Nuclear Phys., Vol. 5, No. 1, 235-55 (Jan., 1958).

Solutions of the $\tau-\theta$ problem are sought whereby one could avoid the conclusion that parity is violated also in weak interactions not involving neutrinos. It is shown that no such solutions can be constructed that are theoretically acceptable, and experimental tests are indicated for a definite disproof of such models. The discussion is limited to the usual description of neutrino interactions such that the known neutrino processes occur at first order in the neutrino constants. A.

530.145

4718. THE CAUSAL FUNCTION AND THE CAUSALITY CONDITION. S.T.Ma.
Nuclear Phys., Vol. 7, No. 2, 163-8 (June [2], 1958).

This article is concerned with the connection between the Stueckelberg—Feynman causal function and the causality condition, i.e. the condition that no disturbance in a wave field can travel faster than light. It contains an analysis of the S-matrix for the scattering of electrons by electrons, and the scattering of nucleons by nucleons, which both involve the causal propagation function for the exchanged bosons. By means of certain mathematical relations for the causal function, the S-matrix is partitioned in such a way that each term by itself fulfils the causality condition for all distances, large or small. The mathematical treatment is applicable to the scattering of any number of fermions with the exchange of any number of bosons. A physical interpretation, according to which the partioned S-matrix describes the various modes of the propagation of retarded action at a distance, is suggested. A.

530.145

4719. LOCALIZATION DOMAIN OF A CLASS OF FIELD STATES. D.Kastler.
C.R. Acad. Sci. (Paris), Vol. 245, No. 23, 2021-3 (Dec. 4, 1957). In French.

A field state is said to be localized in a space-time domain B if it is identical to the vacuum outside B. The field operators are taken as functionals on infinitely differentiable test-functions vanishing outside a compact set. It is proved that for the field states corresponding to polynomials in the free field operators for a finite number of test functions, the localization domain is finite. The case of interacting fields is left open. J.Lascoux

530.145

4720. ON THE RELATIVISTIC TREATMENT OF THE REACTION FORCE OF THE FIELD ON THE SOURCE. E.Bellomo.
Nuovo Cimento, Vol. 8, No. 2, 247-64 (April 16, 1958). In Italian.

A formula is derived in complete generality and using a

relativistic treatment to obtain the self-force for the source, when the field equations have the form $\Box h^A = 0$ (A includes also non-tensorial indices). The self-force is split into two contributions, one responsible for the emission of radiation, the other being attributable to the inertia of the field accompanying the source. As an application, the known results for the electromagnetic field are recovered and it is shown that exactly analogous results hold for the case of an attractive scalar field, containing the self-accelerating solutions for very small sources. It is also shown that in some cases, if the field generates a force which is not orthogonal to the world-line of the source, the reaction force may cause a change in the rest-mass during the period of emission.

P.Roman

530.145 : 530.12

4721. NON-LINEARITY OF THE FIELD IN CONFORMAL RECIPROCITY THEORY. A.Popovich.
Zh. éksper. teor. Fiz., Vol. 32, No. 4, 781-93 (1957). In Russian.
English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 4, 642-51 (Nov., 1957).

The first version of Born and Infeld's non-linear electrodynamics and the variability of the gravitational constant are deduced from the conformally covariant gravitational equations derived from a certain generalized reciprocity law which is based on group theory and yields a non-local field theory. A correspondence principle is established between relativity theory and reciprocity theory. A.

530.145

4722. MEASURING PROCESS AND ALGEBRAIC PROPERTIES OF THE FIELD QUANTITIES IN A SIMPLE MODEL-FIELD THEORY. G.Heber.
Nuovo Cimento, Vol. 8, No. 2, 327-39 (April 16, 1958). In German.

An attempt is made to incorporate into quantum field theory, in an intrinsic way, the limitations of measurability of the field due to the use of real (atomistic) test bodies. The investigations are carried out on a scalar massless model-field. After defining the location of the test body in an appropriate manner, commutation relations are deduced between the field quantities and the observation point, using the commutation rules for the location and momentum of the test body. These are discussed in great detail, and many interesting possibilities are investigated, as for example, that of a bilocal field theory and the elimination of the divergence difficulties.

P.Roman

530.145

4723. CLOTHED PARTICLE OPERATORS IN SIMPLE MODELS OF QUANTUM FIELD THEORY. O.W.Greenberg and S.S.Schweber.
Nuovo Cimento, Vol. 8, No. 3, 378-406 (May 1, 1958).

The idea of using clothed operators in the quantum theory of fields, i.e. operators which create and annihilate one particle eigenstates of the total Hamiltonian, is examined. In cut-off theories, these clothed operators are related to the unrenormalized Schrödinger picture operators by a similarity transformation. In terms of these clothed operators the virtual cloud of particles surrounding a physical particle appearing in present discussions of field theory no longer appears, corresponding to the elimination, in the terminology of Van Hove, of persistent effects. Mass and wave-function renormalization are automatically accomplished by unitary clothing transformations, and the usual renormalization programme is extended to the renormalization of the states appearing in the theory. The form of the Hamiltonian expressed in terms of clothed operators is discussed and these ideas are applied to the static scalar model, the Lee model, and the Ruijgrok–Van Hove model. A.

530.145

4724. SOME REMARKS ON THE INVERSION THEOREMS OF QUANTUM FIELD THEORY. O.Klein.
Nuclear Phys., Vol. 4, No. 5, 677-86 (Nov., 1957).

The new parity situation revealed in experiments on weak interactions suggests the study of the five coordinate inversions of five-dimensional relativity theory. Each of these corresponds to a change of sign of the relevant eight-row Dirac matrix γ_μ ($\mu = 0, 1, 2, 3, 4$). Using this theory as an auxiliary model to a physical theory an eight-component spinor is formed by the combination of a four-component Dirac spinor ψ with its conjugate complex ψ^*. As is then shown the theory is no longer invariant under the old-type space inversion — which would entail a change of sign of γ_0 — but only under the new inversion introduced by Lee and Yang and by Landau, according to which an antiparticle is the mirror image of a particle. A.

530.145

4725. CONTRIBUTION TO FIELD THEORY INVOLVING A CUT-OFF FACTOR. D.A.Kirzhnits.
Zh. éksper. teor. Fiz., Vol. 32, No. 3, 534-41 (1957). In Russian.
English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 3, 445-51 (Oct., 1957).

A study is made of the question of the uniqueness of quantum field theory involving a cut-off factor, and it is found that even finite (renormalized) expressions depend on the form of the cut-off factor. Examples are given in which the renormalized Green's function of a boson has no pole for finite momenta, but the critical momentum in the charge renormalization can be made arbitrarily large. In this connection difficulties with the vanishing of the charge and the existence of a pole in the Green's function are considered, and also the question of the domain of applicability of meson theory. A.

530.145

4726. QUANTUM ELECTRODYNAMICS AT SMALL DISTANCES. S.D.Drell.
Ann. Phys. (New York), Vol. 4, No. 1, 75-86 (May, 1958).

The validity of quantum electrodynamics at small distances is discussed in the light of present experimental information. Large angle pair production in hydrogen, together with elastic electron–proton scattering, is analysed as a means of obtaining further information on the small distance behaviour of quantum electrodynamics. A.

530.145 : 538.3

4727. ON A GEOMETRICAL THEORY OF THE ELECTROMAGNETIC FIELD. D.W.Sciama.
Nuovo Cimento, Vol. 8, No. 3, 417-31 (May 1, 1958).

Weyl's (1929) geometrical theory of gauge (phase) transformations for fermions and the electromagnetic field is generalized so as to apply to bosons as well. This is done by introducing complex base vectors. The resulting theory is closely related to the Einstein–Schrödinger theory in its Hermitian form, and enables one to identify the electromagnetic field tensor. Two physical consequences are deduced from the theory: (a) The charges of all bosons are integer multiples of a basic charge; (b) The direct interaction between a particle and the electromagnetic field is invariant under space reflections and time reflections. A theoretical criterion is suggested, based on the argument leading to (b), for determining which interactions are parity conserving. A.

530.145

4728. ENUMERATION OF THE TRUE OBSERVABLES IN GAUGE-INVARIANT THEORIES. J.L.Anderson.
Phys. Rev., Vol. 110, No. 5, 1197-9 (June 1, 1958).

By making use of invariance arguments, it is shown that the total number of true observables which can serve as "coordinates" in a gauge-invariant theory is $N - 2n$ where N is the number of field variables and n is the number of arbitrary functions needed to specify an element of the gauge group. A.

530.145

4729. LIOUVILLE'S EQUATION AND THE EFFECTIVE CROSS-SECTION. I.Prigogine and F.Henin.
Bull. Acad. Roy. Belgique Cl. Sci., Vol. 43, No. 11, 814-27 (1957). In French.

The Liouville equation for the velocity distribution function of the two-body problem is solved by an iteration method. By means of the solution, the cross-section of the two-body problem can be expressed in terms of the Liouville operator corresponding to the interaction of the particle with the scatterer. This result is applied to the authors' derivation of the "master" equation for dilute gases. A.

530.145

4730. METHOD OF NON-SEPARABLE FIELDS [CHAMPS ADHÉRENTS]. A.Houriet.
Nuclear Phys., Vol. 4, No. 3, 408-26 (Sept., 1957). In French.

A new method of calculation of the nucleon–meson interaction is proposed. It is developed for the case of a pseudoscalar meson field coupled with nucleons by pseudoscalar coupling. The nucleon possesses isobars similar to those of the strong-coupling theory, associated to a nuclear core. A.

530.145

4731. DISPERSION RELATIONS FOR WEAK INTERACTIONS. N.N.Bogolubov, S.M.Bilenky and A.A.Logunov.
Nuclear Phys., Vol. 5, No. 2, 383-9 (Jan. [2], 1958).

Dispersion relations for weak interaction processes are obtained. It is shown that in processes which involve not only

weakly interacting but strongly interacting particles as well, the dispersion relations are equivalent to the statement that the unknown amplitude functions, which are determined by strong interactions, depend only on momentum transfer between strongly interacting particles. A.

530.145

4732. UNIVERSAL FERMI INTERACTION. R.E.Behrends.
Phys. Rev., Vol. 109, No. 6, 2217-18 (March 15, 1958).

The V–A ± (V'–A') form of Fermi coupling is shown to be a consequence of the two theoretical postulates of (a) a two-component neutrino, and (b) independence of the order in which the four fields are written. J C.Taylor

530.145 : 530.12

4733. DIRAC MATRICES IN RIEMANNIAN SPACE.
J.G.Fletcher.
Nuovo Cimento, Vol. 8, No. 3, 451-8 (May 1, 1958).

An explicit formula is developed for the affine spinor connection, Γ_r, in an arbitrary spin representation. This formula makes it possible explicitly to write the Dirac equation in Riemannian space, $\gamma^i(\Psi_{,i} - \Gamma_i\Psi) + m\Psi = 0$, in a form which may be subjected to arbitrary similarity transformations. Also, some useful algebraic properties of Dirac matrices are developed. A.

530.145

4734. LEE MODEL AND QUANTISATION OF NON-LINEAR FIELD EQUATIONS. W.Heisenberg.
Nuclear Phys., Vol. 4, No. 4, 532-63 (Oct., 1957).

In a model for the theory of elementary particles an unconventional method of quantization had been applied which makes use of an indefinite metric in Hilbert space. This method is analysed with the help of the Lee model. The constants of the Lee model can be adjusted in such a manner that, after the renormalization has been carried out, the mathematical structure is in many ways analogous to that of the method of quantization mentioned above. The total Hilbert space can be divided into two parts, one of which has a positive metric and comprises the physical states of the system, while the other one contains "dipole-ghosts" and is needed for the commutation relations and the convergence of the theory. The S-matrix is unitary for the states of Hilbert space I, since the states of Hilbert space II are separated from those of Hilbert space I in a manner similar to the case of "non-combining term systems". Some general results concerning the Hilbert space of indefinite metric are discussed. The questions of causality are briefly raised. The results seem to show that a Hilbert space with indefinite metric can be used for the description of real phenomena. A.

530.145

4735. APPLICATION OF THE TAMM–DANCOFF METHOD TO THE LEE MODEL. W.Heisenberg.
Nuclear Phys., Vol. 5, No. 1, 195-201 (Jan., 1958).

This paper deals with spinor equations. The new Tamm–Dancoff method was applied to the Lee model, after the renormalization for the special case of the "dipole-ghost" was carried out. The Tamm–Dancoff method leads to the exact solutions. Contravariant representations of the state vectors by means of the renormalized operators can be found only if these operators are spread out over finite time intervals, i.e. if integrals of the operators over finite time intervals are applied to the state vector of the vacuum. A.

530.145

4736. GENERAL COVARIANCE AND ELEMENTARY PARTICLES.
R.Finkelstein.
Phys. Rev., Vol. 110, No. 5, 1200-3 (June 1, 1958).

It is suggested that quantization of the generally covariant field equations be carried out in an associated six-dimensional flat space, and that the corresponding eight-rowed spinor be identified with an elementary baryon. It is possible to associate with the new dichotomic variable two (nonorthogonal) states, one of parity and one of strangeness. A.

530.145

4737. CONNECTION BETWEEN SPIN AND STATISTICS.
G.Lüders and B.Zumino.
Phys. Rev., Vol. 110, No. 6, 1450-3 (June 15, 1958).

The proof of the connection between spin and statistics for interacting fields is divided into two parts: commutation relations involving components of a single field, and commutation relations between different fields. The first problem is treated in this paper: the connection between spin and statistics is shown to follow from a few simple postulates. The explicit discussion is limited to the cases of spin zero and of spin one-half. A.

530.145

4738. SOME RELATIVISTIC PROPERTIES OF THE BEHAVIOUR OF SPIN-½ PARTICLES. P.E.Kunin and I.M.Taksar.
Zh. éksper. teor. Fiz., Vol. 32, No. 3, 506-9 (1957). In Russian.
English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 3, 426-8 (Oct., 1957).

It is shown that in the case of a scalar field the Klein paradox does not arise for spin-½ particles tunnelling through a potential barrier. The particle does not fall toward the centre of a centrally symmetric field even when a high-order pole exists in the centre. This result also holds in classical relativistic theory. A.

530.145

4739. CONCERNING SOME POSSIBILITIES OF FORMULATION OF A RELATIVISTICALLY INVARIANT THEORY OF EXTENDED PARTICLES. V.S.Barashenkov.
Zh. éksper. teor. Fiz., Vol. 32, No. 3, 566-9 (1957). In Russian.
English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 3, 470-2 (Oct., 1957).

Various problems pertaining to the theory of extended particles are examined in the case of the classical (non-quantum) theory of interacting dynamically indeformable extended particles. Although the structure of the theory is not of the Hamiltonian type, a formulation in Lagrangian variables x_k, $\dot{x}_k$, A_μ, $\dot{A}_\mu$, as well as Hamiltonian variables x_k, p_k, A_μ, π_μ can be given. The possibility of a many-time formalism is examined and the latter is found to be non-unique. However, in none of the cases was a transition to a single-time theory found and the system of equations of motion was found to be inconsistent. A.

530.145 : 539.12

4740. ON THE EQUATIONS OF TWO-BODY COLLISIONS.
R.R.Warnecke and J.M.Dolique.
Ann. Radioelect., Vol. 13, 89-106 (April, 1958). In French.

Formulae for the dynamics of two-body collision are given in the c.m. and laboratory systems. The results obtained are applied to the evaluation of Vekssler's coherent acceleration and the collision of two opposite beams of particles. J.Lascoux

530.145

4741. RECONSTRUCTION OF THE SCATTERING MATRIX OF A TWO-NUCLEON SYSTEM.
L.Puzikov, R.Rÿndin and Ya.Smorodinskiĭ.
Zh. éksper. teor. Fiz., Vol. 32, No. 3, 592-600 (1957). In Russian.
English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 3, 489-95 (Oct., 1957).

The types of experiments needed for determination of all elements of the scattering matrix are investigated. It is shown that because of the unitarity condition the required number of experiments equals the number of complex functions entering into the scattering matrix. For nucleon–nucleon scattering, the inelastic scattering matrix can be determined on the basis of five experiments measuring the cross-section, polarization, normal components of the polarization correlation tensor and of the triple scattering tensors (for the scattered and recoil particles). It is shown that experiments involving spin rotation by a magnetic field are not necessary for a phase-shift analysis. A.

530.145

4742. TWO-PARTICLE APPROXIMATIONS FOR THE MANY-BODY PROBLEM. I. W.Brenig.
Nuclear Phys., Vol. 4, No. 3, 363-74 (Sept., 1957). In German.

The Schrödinger equation for the many-body problem is replaced by a system of coupled equations between one-particle, two-particle, ... n-particle functions. The energy may be expressed in terms of only one- and two-particle functions. Arguments are given that it should be possible to approximate three- and four-particle functions by products of one- and two-particle functions. The resulting equations are essentially those given by Brueckner, Eden and Bethe. The results are derived without using perturbation theory. A.

530.145

4743. SOME PROPERTIES OF COMBINED PC-TRANSFORMATION AND ASSOCIATED SELECTION RULES. P.Roman.
Nuclear Phys., Vol. 4, No. 4, 564-78 (Oct., 1957).

The transformation rules were derived for the creation and annihilation operators of baryon and lepton fields under a combined charge-conjugation and space-reflection operation, and eigenstates of the corresponding operator were found. Also properties of the "squared" operation are studied, giving a distinction between baryon and lepton fields from which some selection rules are derived. The π- and K-meson fields are also studied and some consequences of

K-decay are investigated. Then, assuming a universal Fermi interaction, it is proved that the number of baryons is conserved if the invariance of the interaction under a combined charge-conjugation and space-reflection transformation is required. Some selection rules for allowed processes are also studied. A.

530.145

4744. BEHAVIOR OF THE MESON—NUCLEON CROSS SECTION AT HIGH ENERGIES. R.Arnowitt and G.Feldman.
Phys Rev., Vol. 108, No. 1, 144-7 (Oct. 1, 1957).

It is shown that within the context of a local causal field theory the total π-nucleon cross-section $\sigma(\omega)$ has the following behaviour at high energies: $\lim_{\omega\to\infty}\omega\sigma(\omega) > 0$. A.

530.145

4745. SEMICLASSICAL LIMIT FOR EXCITATION OF ROTATIONAL MOTION BY SCATTERING. D.M.Chase.
Phys. Rev., Vol. 110, No. 3, 673-5 (May 1, 1958).

The problem of scattering of particles by a quantum-mechanical symmetric top, with an interaction consisting of a potential well symmetric about the figure axis, is studied in an approximation in which the motion of the top is treated classically. The time-modulated, adiabatic, elastic-scattering amplitude is Fourier-analysed, and the components are associated with rotational excitations. Cross-sections, averaged over the azimuth of the target angular momentum, are directly comparable with results from the quantum-mechanical adiabatic approximation. Exact correspondence is found in the envisaged limit by virtue of a limiting form for Clebsch—Gordon coefficients. A similar limiting form is given for Racah coefficients. A.

530.145

4746. INELASTIC SCATTERING. R.G.Newton.
Ann. Phys. (New York), Vol. 4, No. 1, 29-56 (May, 1958).

Many-channel scattering is studied in a formulation general enough to be applicable, for example, to the scattering of bound systems by one another, such as in nuclear reactions, or to strange particle reactions in which incoming and outgoing particles have different masses. The assumptions made concerning the interaction potentials are relatively weak, no finite nuclear radius being assumed. Effects investigated include threshold phenomena and resonance scattering. Regarding the first, an alternative to the Wigner cusp is found. The Breit—Wigner resonance formula is rederived in a perturbation calculation which assumes neither large level spacings compared to the widths nor poles of the S matrix. It includes among the resonance terms only compound nucleus states, which are defined here uniquely by means of the average particle interactions. A.

530.145

4747. CAUSAL AMPLITUDES AND THE YANG—FELDMAN FORMALISM. J.C.Polkinghorne.
Proc. Cambridge Phil. Soc., Vol. 53, Pt 4, 843-7 (Sept., 1957).

The Yang—Feldman formalism using the Feynman-like Green's functions is set up. The corresponding free fields have non-trivial commutation relations and contain information about the scattering. S-matrix elements are simply the matrix elements of antinormal products of the field $\phi^{F'}(x)$. These are evaluated, and they give directly expressions used in the theory of causality and dispersion relations. It is possible to formulate field theory in a form in which the fields obey free field equations and the effects of interaction are contained in their commutation relations. A.

530.145

4748. ON THE POSSIBILITY OF FORMULATING A MESON THEORY WITH SEVERAL FIELDS. A.D.Galanin.
Zh. éksper. teor. Fiz., Vol. 32, No. 3, 552-8 (1957). In Russian.
English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 3, 460-4 (Oct., 1957).

The following cases of interaction of several fields are considered: (1) N fermion and n boson fields with the same coupling constant, (2) two fermion and two boson fields, interacting with different constants, (3) fermion and boson fields with different isotopic properties. In all cases considered the physical charge tends to zero as the extended interaction approaches a point interaction. A.

530.145 : 539.12

4749. SOME PROBLEMS RELATED TO THE STATISTICAL THEORY OF MULTIPLE PRODUCTION OF PARTICLES. V.M.Maksimenko and I.L.Rozental'.
Zh. éksper. teor. Fiz., Vol. 32, No. 4, 658-66 (1957). In Russian.
English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 4, 546-51 (Nov., 1957).

The exact values of the statistical weights of a system consisting of N particles of arbitrary masses are computed by taking into account the laws of conservation of energy and momentum. The solution is expressed as a series expansion in terms of the ratio $\nu_i = M_i/E_0$ (M is the mass of the particle and E_0 is the total energy of the system). Since the obtained series converges slowly, another expansion in the form of a power series of the ratio of the total kinetic energy of the system to the total mass of the heavy particles was obtained for values of ν_i which are close to unity. A.

530.145

4750. MOMENT OF INERTIA OF A SYSTEM OF INTERACTING PARTICLES. A.S.Davydov and G.F.Filippov.
Zh. éksper. teor. Fiz., Vol. 32, No. 4, 826-36 (1957). In Russian.
English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 4, 676-84 (Nov., 1957).

The problem of singling out the collective degrees of freedom of a system consisting of N interacting particles is considered. It is shown that for some special states of internal motion, the energy of the system in the centre-of-mass system can be represented as the sum of the energy of internal motion and the rotational energy. The concept of the moment of inertia of a system of N interacting particles is introduced. A.

530.145

4751. ON THE PROPAGATION OF CASCADES IN A MULTILAYER MEDIUM. Kh.Ya.Khristov.
Zh. éksper. teor Fiz., Vol. 33, No. 4(10), 877-82 (1957). In Russian.

A cascade of several types of particles propagating in a medium composed of homogeneous layers R^λ is considered. The boundaries of the layers may be mobile. The particles of the cascade collide with the particles of the medium, and in the process they are absorbed, scattered and generate new particles. Functions W^λ are sought to give the distribution of particles of each type according to positions and velocities on the assumption that functions V^λ, which give the distribution of particles in each layer R^λ if it occupied the whole space, are known. For the unknown functions W^λ an infinite series of integrals is given which, in general, shows good convergence. The subintegral functions of these integrals are certain products of the functions V^λ. A.

530.145

4752. ON CORRELATIONS IN THE DISTRIBUTION OF CASCADE PARTICLES. Kh.Ya.Khristov.
Zh. éksper. teor. Fiz., Vol. 33, No. 4(10), 883-8 (1957).
In Russian.

A cascade is considered which is made up of several types of particle that move in a given, in general nonhomogeneous, medium whose properties vary with time. They collide with the particles of the medium and in this process are absorbed, scattered, and generate new cascade particles. The probability is found for the joint presence of given numbers of cascade particles at given instants in given regions of positions and velocity. The probability is found also for the recording of these particles by means of devices which are able to record each entrant particle with a certain probability that depends on the type and velocity of the particle and on the instant and place of its entrance into the recording apparatus. A.

530.145 : 539.12 : 539.14

4753. NUCLEAR FORCES AND THE SCATTERING OF π-MESONS. Yu.V.Novozhilov.
Zh. éksper. teor. Fiz., Vol. 33, No. 4(10), 901-9 (1957). In Russian.

The interaction of two bound nucleons is considered in pseudoscalar meson theory with pseudovector coupling. The principal part of the functional of the two-nucleonic state is represented in the form of the product of single-nucleonic functionals. Consideration is given only to a state without real mesons and with one real meson. A procedure is developed for reducing two-nucleonic renormalized matrix elements to single-nucleonic ones, which are then calculated by the method of Chew, Low and Wick (Abstr. 2680, 4208/1956). The potential of order $e^{-\frac{1}{4}R}$ is calculated. It consists of two parts: one part is proportional to f^4 (f is the interaction constant), and the other is a function of the phases of π-meson scattering on nucleons. A.

530.145 : 530.162

4754. THE METHOD OF "SECONDARY QUANTIZATION" IN PHASE SPACE. Yu.L.Klimontovich.
Zh. éksper. teor. Fiz., Vol. 33, No. 4(10), 982-90 (1957). In Russian.

The number of particles in various points of phase space of coordinates and momenta, which for any point of phase space are

random functions of time, were used as independent variables in the statistical description of processes in systems of interacting particles. For these functions the classical and quantum equations are given, from which, by averaging over their distribution functions, chains of equations were obtained for the classical and quantum distribution functions. To illustrate the possible use of this method expressions were obtained for the excitation spectrum and the correlation function for a system of particles with central interaction for the case when short-distance interactions are not important. This method is convenient for considering systems of particles with field interaction, for example electromagnetic interaction. It may be generalized for the relativistic case. A.

530.145

4755. CONTRIBUTION TO THE THEORY OF COLLECTIVE MOTION OF PARTICLES IN QUANTUM MECHANICAL SYSTEMS. V.M.Eleonskiĭ and P.S.Zȳryanov.
Zh. éksper. teor. Fiz., Vol. 32, No. 3, 515-19 (1957). In Russian. English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 3, 432-5 (Oct., 1957).

A method for separating the collective motions in a system of interacting particles is presented. The connection between this method and earlier work is established. An attempt is made to give a basis to the generalized heavy nucleus model. A.

530.145

4756. THE WAVE MECHANICS OF THE PHOTON OF ZERO MASS. R.Potier.
C.R. Acad. Sci. (Paris), Vol. 246, No. 14, 2106-8 (April 9, 1958). In French.

A theory is given which takes account of the Coulomb field. An interpretation of gauge invariance is proposed.

P.M.Davidson

530.145

4757. SPIN FUNCTIONALS. J.Aharoni.
Nature (London), Vol. 181, 1385-6 (May 17, 1958).

As no unitary representations of finite dimensions of the Lorentz group exist (trivial ones apart), functions of variables taking only a finite number of values and thus associated with Hilbert spaces of finite dimensions, cannot represent quantum mechanical states. In particular, spin functions must be generalized to spin functionals, whose construction is described. It is shown that unitary representations of the Lorentz group are possible in the Hilbert space of functionals, on suitably defining the scalar product. A representation of the Pauli matrices in this space is given. M.J.Kearsley

530.145 : 539.14

4758. ROTATIONAL PROPERTIES OF THE TWO-DIMENSIONAL ANISOTROPIC HARMONIC OSCILLATOR. I. EXPECTATION VALUES. H.J.Lipkin and S.Goldstein.
Nuclear Phys., Vol. 5, No. 1, 202-10 (Jan., 1958).

Expectation values are given for operators useful in unified nuclear model calculations with anisotropic harmonic oscillator wave-functions. The operators chosen are of particular interest in regard to a description of the oscillator system in terms of collective and intrinsic coordinates. A.

530.145

4759. ON THE THEORY OF PERTURBATIONS OF BOUND STATES. C.Bloch.
Nuclear Phys., Vol. 6, No. 3, 329-47 (April [1], 1958). In French.

Two methods leading to general prescriptions for the construction of the time-independent perturbation expansions for bound states to all orders are discussed. The two methods differ by the choice of the zeroth-order wave-functions. In both cases, the expansions are simplified by the use of non-orthonormalized zeroth-order wave-functions. The terms of the expansions are described by means of diagrams. The accuracy of the expansions is tested by a calculation of two eigenvalues of the Mathieu equation. A.

530.145

4760. SIMPLE EXPANSION FOR THE REGULAR COULOMB WAVE FUNCTION. A.S.Meligy.
Nuclear Phys., Vol. 6, No. 3, 440-2 (April [1], 1958).

The procedure employed by Shepanski and Butler (Abstr. 7153/1956) for the expansion of the regular radial Coulomb wave-function was modified, leading to a simple expansion of the same rapidity of convergence. A.

530.145

4761. SIMPLE METHOD OF INTERPOLATION FOR COULOMB WAVE FUNCTIONS. A.S.Meligy.
Proc. Phys. Soc., Vol. 71, Pt 6, 1017-18 (June, 1958).

An expansion of the regular radial Coulomb wave-functions $F_L(\eta,\rho)$ is derived, which enables interpolation with respect to η to be performed without using tables of reduced derivatives.

M.J.Kearsley

530.145

4762. NEW RECURSION RELATION FOR THE CLEBSCH–GORDAN COEFFICIENTS. J.D.Louck.
Phys. Rev., Vol. 110, No. 4, 815-16 (May 15, 1958).

A recursion relation for the Clebsch–Gordan coefficients is presented which will facilitate the construction of further tables.

A.

530.162

4763. CLASSICAL THEORY OF BOSON WAVE FIELDS. E.P.Gross.
Ann. Phys. (New York), Vol. 4, No. 1, 57-74 (May, 1958).

The subject of discussion is the Hamiltonian for a system of bosons interacting by two body forces, as expressed in the formalism of second quantization. Properties are examined of the classical wave field governed by the Hamiltonian. For a general potential there is always an exact solution representing a uniform density. Exact solutions are exhibited, which represent disturbances of a definite velocity and of arbitrary amplitude. For small amplitudes the disturbances obey Bogolyubov's dispersion relation. Corresponding solutions are found for disturbances when the system moves as a whole. For suitably attractive potentials a class of exact solutions is found, degenerate in energy, with spatially periodic density. These solutions have a lower energy than the uniform type. Small amplitude excitations are investigated for the periodic case. They are phonons for long wavelengths, but show a band character at shorter wavelengths. A theory of the motion of foreign atoms in the boson fluid is formulated. A.

530.162

4764. DISTRIBUTION FUNCTIONS FOR THE CLASSICAL ELECTRON GAS. S.V.Tyablikov and V.V.Tolmachev.
Dokl. Akad. Nauk SSSR, Vol. 114, No. 6, 1210-13 (1957). In Russian.

The approximate radial distribution function

$$G(r) = 1 - (v/rr_d^3)\exp(-r/r_d)$$

[this formula is probably $G(r) = 1 - (v/4\pi r r_d^3)\exp(-r/r_d)$ — Abstractor], obtained by Bogolyubov (1946), is negatively biased when r is small. An improved expression

$$G(r) = \exp[(-e^2/\theta r)\exp(-r/r_d)]$$

is obtained, where e = charge on electron, θ = kT, T = absolute temperature, r_d = effective (Debye) radius of electron, and $r_d^2 = v\theta/4\pi e^2$, where v = volume of one particle. N.L.Johnson

530.162 : 621.391

4765. ZEROS OF GAUSSIAN NOISE. G.M.White.
J. appl. Phys., Vol. 29, No. 4, 722-9 (April, 1958).

An experiment was designed for generating and measuring the zeros of Gaussian noise having various spectral shapes. Several experimentally determined distributions and statistics are presented. Those that could be checked with numerical calculations (e.g. $P[+z(t)|+z(0)]$, the probability of finding a zero in an increment of time Δt, t seconds after a zero has occurred) agreed closely with their calculated values. The others, e.g. W(N,T), the number of zeros in an increment of time T, verified what would be intuitively expected. The equipment used is briefly described. A.

530.162

4766. PERCOLATION PROCESSES. I. CRYSTALS AND MAZES. S.R.Broadbent and J.M.Hammersley.
Proc. Cambridge Phil. Soc., Vol. 53, Pt 3, 629-41 (July, 1957).

The paper studies, in a general way, how the random properties of a "medium" influence the percolation of a "fluid" through it. The treatment differs from conventional diffusion theory, in which it is the random properties of the fluid that matter. Fluid and medium bear general interpretations; for example, solute diffusing through solvent, electrons migrating over an atomic lattice, molecules penetrating a porous solid, disease infecting a community, etc.

A.

530.162

4767. PERCOLATION PROCESSES. II. THE CONNECTIVE CONSTANT. J.M.Hammersley.
Proc. Cambridge Phil. Soc., Vol. 53, Pt 3, 642-5 (July, 1957).

This paper supplies the proof of the theorem on the connective constant of a crystal, omitted in Pt I (see the preceding abstract). A.

530.162 : 539.12

4768. TRANSFER PROBLEMS AND THE RECIPROCITY PRINCIPLE. K.M.Case.
Rev. mod. Phys., Vol. 29, No. 4, 651-63 (Oct., 1957).

An elegant proof of a general reciprocity principle, which is expressed as a relatively simple identity, is given and a uniqueness theorem is derived. Various reciprocity principles given by previous authors are shown to be special cases of this general reciprocity principle. The method of proof has the advantages that the origin of other theorems and their generalizations in more complex situations are directly apparent, and that several equations used to determine angular densities are obtained at the same point in the analysis. These equations can be applied to problems in radiative equilibrium and in neutron diffusion; the terminology of the latter subject is used throughout the paper. Several of the results previously obtained by Chandrasekhar (Radiative Transfer. London: Oxford University Press, 1950) are produced in this way in a form applicable to neutron diffusion problems. Green's function for a half-space and for two adjacent half-spaces, assuming isotropic scattering, are also obtained. A.J.Salmon

530.19

4769. LIOUVILLE'S THEOREM AND THE INTENSITY OF BEAMS. A.Arakengy.
Amer. J. Phys., Vol. 25, No. 8, 519-25 (Nov., 1957).

The meaning of Liouville's theorem on the flow of points in a phase space is discussed. The intensity for particles or for radiation is defined in the most general case. It is shown that the familiar theory, which states that an optical instrument cannot change the brightness of any object which it images, is a special case of Liouville's theorem. The generalization of this result to classical particle- and radiation-handling systems of many kinds is discussed. The result holds even for situations in which the fields or refractive index distributions are arbitrarily varying in time, though in such situations the trajectories of "constant brightness" may move around by bending and distorting so that a stationary observer may thereby see some changes. The problem of point sources is considered. Simple examples of phase space motions are exhibited. A.

530.19

4770. THE SMOOTHING OF TEMPERATURE FLUCTUATIONS BY RADIATIVE TRANSFER. F.A.Spiegel.
Astrophys. J., Vol. 126, No. 1, 202-7 (July, 1957).

A time-dependent equation for the temperature field of a medium with deviations from radiative equilibrium is derived. It is assumed that the medium is greylike and changes quasi-statically. Perturbations of small amplitude imposed on a homogeneous medium are shown to decay exponentially in time. The dependence of decay time on a characteristic length of the perturbation is found. A.

530.19

4771. THE PROBABILISTIC METHOD FOR PROBLEMS OF RADIATIVE TRANSFER. II. MILNE'S PROBLEM. S.Ueno.
Astrophys. J., Vol. 126, No. 2, 413-17 (Sept., 1957).

Based on the probability theory, the multiple scattering of photons is treated classically for Milne's problem in half-space with isotropic scattering. Assuming that the multiple scattering under consideration is of Markovian property, the stochastic integro-differential equation is derived for the probability distribution of emission from the modified Chapman—Kolmogoroff equation. This diffusion equation is mathematically equivalent to the equation due to Ambarzumian. With the aid of the scattering operator defined by it and partly by the Ambarzunian first method, the exact solution is obtained of the restricted Milne problem without actually solving the Milne first integral equation by explicitly referring to the integral transformation, using Chandrasekhar's idea. A.

530.19 : 523.03

4772. MILNE'S PROBLEM WITH AN ARBITRARY INDICATRIX. M.V.Maslennikov.
Dokl. Akad. Nauk SSSR, Vol. 118, No. 5, 895-8 (1958). In Russian.

Milne's problem about the diffusion of radiation in a plane parallel dispersive and absorbing medium filling half of three dimensional space reduces to an integral equation. For a dispersion probability density of polynomial form Wiener—Hopf methods can be used to investigate the integral equation, but here, in the general case, the integral equation with an arbitrary indicatrix must be studied directly. By making suitable less restricted assumptions about the dispersion probability density, it is shown that the integral equation is closely connected with a certain characteristic equation, whose eigenvalues, eigenfunctions and related properties are investigated in detail. Expressions are given relating the phase density of radiation at a given optical depth with that at zero optical depth. M.J.Kearsley

530.19

4773. RADIATIVE TRANSFER IN DISCONTINUOUS MEDIA. R.G.Giovanelli.
Austral. J. Phys., Vol. 10, No. 2, 227-39 (June, 1957).

The theory of radiative transfer is applied to a scattering and absorbing medium consisting of randomly distributed spherical regions of uniform extinction and scattering coefficients κ and σ, separated by free space. A general discussion of the diffusion of radiation through an infinite medium is followed by an approximate treatment of the semi-infinite case. It is shown that the reflectance may be very much lower than that of a uniform, continuous semi-infinite medium having the same value of σ/κ; the reflectance is obtained as a function of σ/κ and of the size and mean separation of the spherical regions. A.

530.19

4774. DIFFUSION OF RADIATION IN A MEDIUM OF FINITE OPTICAL THICKNESS. V.V.Sobolev.
Astron. Zh., Vol. 34, No. 3, 336-48 (1957). In Russian.

A theoretical treatment of diffusion of radiation in an isotropic medium bounded by two parallel planes, with special reference to the case where the medium has a large optical thickness. Expressions are derived for the intensity of radiation escaping from the medium for different distributions of sources of radiation. These results may be used in the study of diffusion of radiation in nebulae, planetary atmospheres etc. S.Chomet

530.19

4775. COOPERATIVE PHENOMENA IN QUANTUM THEORY OF RADIATION. A.Gamba.
Phys. Rev., Vol. 110, No. 3, 601-3 (May 1, 1958).

Cooperative phenomena in a radiating system were discussed by Dicke (Abstr. 3248/1954). A new formulation of the theory is presented, which shows more clearly the relations of these effects with the quantum-mechanical identity principle. Some theoretical and practical implications of the theory are pointed out. A.

MECHANICS OF SOLIDS

531.51 : 523.8

4776. CONSTANT CONFIGURATIONS IN THE PROBLEM OF FOUR BODIES, AND THEIR STABILITY. V.A.Brumberg.
Astron. Zh., Vol. 34, No. 1, 55-74 (1957). In Russian.

Stability of some special circular solutions of the four body problem is considered. The following special configurations are treated in detail: straight line (conditionally stable), square (conditionally stable), rhombus (unstable), equilateral triangle (unstable). An attempt is made to apply the theory of constant configurations to the stars of the Trapezium of Orion. The latter is taken as consisting of four bodies A,B,C,D such that CD = AC and the masses of D and A are equal. It is shown that within the limits of this model the Trapezium of Orion cannot form a plane constant configuration. It is possible, however, that these stars form a spatial constant configuration. S.Chomet

531.55 : 523.3 : 525.3

THE DYNAMICS OF FLIGHT TO THE MOON. See Abstr. 4692

531.57

4777. ON THE RICOCHET MOTION OF A PROJECTILE STRIKING A WATER SURFACE. T.Huzita.
J. Phys. Soc. Japan, Vol. 12, No. 2, 208-13 (Feb., 1957).

Analysing photographs of the ricochet motion, the following results were obtained. (1) The mean hydrodynamic impulsive force is practically independent of the incident angle except for blunt-head projectiles. (2) The horizontal component of the force becomes smaller as the incident angle increases and the projectile becomes difficult to ricochet as the component nears zero. (3) The point of application of the force recedes as the incident angle increases. (4) The vertical velocity component of the projectile after the ricochet is generally greater than that before. A coefficient of retardation, a coefficient of ricochet, and a coefficient of slip are introduced. A.

MECHANICS OF FLUIDS

532.13 : 536.48

THE VISCOSITY OF LIQUID HELIUM BETWEEN 0.78°K AND 1.1°K. See Abstr. 3943

532.133

4778. DYNAMIC DETERMINATION OF VISCOSITY.
A.Carrelli and E.Ragozzino.
Nuovo Cimento, Vol. 8, No. 2, 356-8 (April 16, 1958).

A cylinder was oscillated in liquid contained in a concentric cylinder, at a frequency of 150 c/s. The limiting amplitude at large annular gaps (which is attained in practice at gaps of a few mm in the apparatus used) is proportional to (viscosity × density)$^{-1/2}$ in simple liquids, but not in some solutions of macromolecules (e.g. nylon in formic acid). J.G.Oldroyd

532.14 : 533.12 : 536.48

4779. OPTICAL DETERMINATION OF THE DENSITY OF He^3.
V.P.Peshkov.
Zh. éksper. teor. Fiz., Vol. 33, No. 4(10), 833-8 (1957). In Russian.

An interference method is described for determining the density of gaseous and liquid He^3. The molar polarization for He^3 is A = 0.123 cm^3/mole. It is shown that at temperatures and pressures below critical, the equation of state of gaseous He^3 is described by the formula: $p/\rho = 27.35T - 2.3 \times 10^3\rho + 1.8 \times 10^4\rho^2$, where p/ρ is in atm cm^3/g. The compressibility curves of liquid He^3 were determined. For the critical point, the following values were obtained $T_c = 38 \pm 0.03^0$ K, $p_c = 930 \pm 20$ mm Hg, $\rho_c = 0.041 \pm \pm 0.001$ g/cm^3. A.

532.5 : 538.3 : 536.252

APPARATUS FOR STUDYING CONVECTION UNDER THE SIMULTANEOUS ACTION OF A MAGNETIC FIELD AND ROTATION. See Abstr. 3927

532.517.2

4780. VISCOUS FLOW AT LOW REYNOLDS NUMBERS PAST AN INFINITE ROW OF EQUAL CIRCULAR CYLINDERS.
T.Miyagi.
J. Phys. Soc. Japan, Vol. 13, No. 5, 493-6 (May, 1958).

The steady viscous flow, at low Reynolds numbers, through an infinite row of parallel, circular cylinders of the same radius is investigated on the basis of the Stokes' equations of motion. Tamada and Fujikawa's expansion formula for the drag coefficient is extended up to the 14th power of the diameter—distance ratio of the row. An alternative simple formula is presented for the case where the ratio approaches unity, so that the aforementioned expansion formula becomes divergent. The relation between the drag coefficient and the diameter—distance ratio of the row is discussed. A.

532.517.2

4781. THE WALL-EFFECT UPON THE FORCES EXPERIENCED BY AN ELLIPTIC CYLINDER IN A VISCOUS LIQUID. Y.Takaisi.
J. Phys. Soc. Japan, Vol. 13, No. 5, 496-506 (May, 1958).

The steady, slow motion of an elliptic cylinder having an arbitrary angle of attack in a viscous liquid, bounded either by a plane wall or by two parallel plane walls, is discussed on the basis of Oseen's linearized equations of motion. The analytical expressions for the lift and drag coefficients are obtained to a first approximation, and numerical calculations are carried out for the following thickness ratios: 0, 0.1, 0.5 and 1. It is found that the wall-effect upon the lift is in both cases much greater than that on the drag. A.

532.517.4

4782. RELATION OF FOURTH ORDER TO SECOND ORDER MOMENTS IN STATIONARY ISOTROPIC TURBULENCE.
R.H.Kraichnan.
Phys. Rev., Vol. 107, No. 6, 1485-90 (Sept. 15, 1957).

An investigation is made of the hypothesis that the fourth order moments of the two-time velocity amplitude distribution in stationary, isotropic, incompressible turbulence are related to second order moments as in a normal distribution. It is concluded that this hypothesis is inconsistent with the equations of motion, and the inconsistency is exhibited as a gross violation of energy conservation in the inertial range. The origin of the inconsistency is discussed. The arguments developed are used to demonstrate inconsistencies in Chandrasekhar's recent theory of turbulence (Abstr. 3852/1956). Qualitative considerations are presented with regard to the consistency of the hypothesis that fourth order moments of the simultaneous amplitude distribution are related to second order moments as in a normal distribution. The general validity of this restricted hypothesis is questioned also. A.

532.522

4783. DEFINITION AND PHYSICAL SIGNIFICANCE OF THE FLOW COEFFICIENT IN ACCELERATED FLOW, WITH SPECIAL REFERENCE TO METERING DEVICES. T.H.Redding.
J. Electronics and Control, Vol. 3, No. 4, 409-38 (Oct., 1957).

532.528

4784. THE MECHANISM OF CAVITATIONAL DAMAGE OF SOLIDS. A.S.Bebchuk.
Akust. Zh., Vol. 3, No. 4, 369-71 (1957). In Russian.

The amount of cavitational destruction was found to vary with the saturated vapour pressure and the gas content of the liquid. The greater the solubility coefficient of the gas the less the destruction. C.R.S.Manders

532.59

4785. ON SHORT-PERIOD INTERNAL GRAVITY WAVES.
B.Heyna and P.Groen.
Physica, Vol. 24, No. 5, 383-9 (May, 1958).

A proof is given of two theorems applying to small-amplitude internal gravity waves: (1) the periods of simple harmonic, small-amplitude, internal gravity waves in a vertically inhomogeneous, stably stratified incompressible fluid having either a free surface or a rigid horizontal upper boundary, are monotonic increasing functions of the wavelength; (2) there is a positive lower limit to the periods of small-amplitude internal gravity waves in a stably stratified, incompressible fluid having a lapse rate of density which is a continuous function of height, and having either a free surface or a rigid horizontal upper boundary. This lower limit is the minimum value of $2\pi\sqrt{-\rho}/g\rho'$ and is the limit of the periods for $\lambda \to 0$. H.J.H.Starks

532.595

4786. ON THE EFFECT OF FORMATION OF A FOUNTAIN OF DROPS FROM THE SURFACE OF A VERTICALLY OSCILLLATING LIQUID. V.I.Sorokin.
Akust. Zh., Vol. 3, No. 3, 262-73 (1957). In Russian.

A fountain of drops is shown to come about with excitation of surface-tension—gravitational standing waves at the free liquid surface. The calculated value of the excitation threshold of the waves is confirmed experimentally. C.R.S.Manders

532.63

4787. ASCENT OF A LIQUID IN CAPILLARIES OF VARIABLE SECTION AND CAPILLARY HYSTERESIS.
M.M.Kusakov and D.N.Nekrasov.
Dokl. Akad. Nauk SSSR, Vol. 119, No. 1, 107-9 (1958). In Russian.

A theoretical and experimental investigation of the rise of a non-viscous liquid in capillaries of diverging and converging conical bore, and of bore varying sinusoidally with distance along the tube. For conical tubes, there is one equilibrium height of rise if the bore diverges, and two if it converges; for a sinusoidal bore the number of equilibrium heights may be greater (9 in an example quoted), and the equilibrium at these heights is alternately stable and unstable. R.F.S.Hearmon

MOLECULAR THEORY OF LIQUIDS

532.7

4788. RADIAL DISTRIBUTION FUNCTION OF FLUIDS. I.
K.Hiroike.
J. Phys. Soc. Japan, Vol. 12, No. 4, 326-34 (April, 1957).

The consistency of several approximate radial distribution functions of fluids is examined in the sense that the pressure and the internal energy derived from them satisfy the thermodynamical relation $\frac{\partial}{\partial T}\left(\frac{p}{T}\right) = \frac{\partial}{\partial V}\left(\frac{E}{T}\right)$, where T, p, V and E have the usual meanings. It is found that the original form of Green's linear theory is the only one which satisfies the above relation. It is also shown that Green's theory can be improved further without breaking the above relation. A.

532.7

4789. RADIAL DISTRIBUTION FUNCTION OF FLUIDS. II.
K.Hiroike.
J. Phys. Soc. Japan, Vol. 12, No. 8, 864-73 (Aug., 1957).

It is shown that the radial distribution function of fluid can be derived from the expression for the free energy in the form of a "functional derivative" with res ect to the pair interaction potential. Three examples are treated on the lines of the theory: (1) the simple chain approximation of classical fluids, (2) the second quantization and (3) the lowest state of the spinless bosons derived by Bogolyubov and Zubarev. A procedure, which differs from the usual one, is given in the derivation of the expressions by which the pressure and the internal energy are expressed in terms of the radial distribution function. A.

532.71

4790. THE BOUNDARY CONDITIONS GOVERNING FLUID MOTIONS IN POROUS MEDIA. J.R.Philip.
Austral. J. Phys., Vol. 10, No. 4, 587 (Dec., 1958).

Continuation of work described in Abstr. 5916 (1957).

532.72

4791. THE PENETRATION OF A FLUID INTO A POROUS MEDIUM OR HELE-SHAW CELL CONTAINING A MORE VISCOUS LIQUID. P.G.Saffman and G.Taylor.
Proc. Roy. Soc. A, Vol. 245, No. 1242, 312-29 (1958).

When a viscous fluid filling the voids in a porous medium is driven forwards by the pressure of another driving fluid, the interface between them is liable to be unstable if the driving fluid is the less viscous of the two. This condition occurs in oil fields. To describe the normal modes of small disturbances from a plane interface and their ate of growth, it is necessary to know, or to assume one knows, the conditions which must be satisfied at the interface. The simplest assumption, that the fluids remain completely separated along a definite interface, leads to formulae which are analogous to known expressions developed by scientists working in the oil industry, and also analogous to expressions representing the instability of accelerated interfaces between fluids of different densities. In the latter case the instability develops into round-ended fingers of less dense fluid penetrating into the more dense one. Experiments in which a viscous fluid confined between closely spaced parallel sheets of glass, a Hele-Shaw cell, is driven out by a less viscous one reveal a similar state. The motion in a Hele-Shaw cell is mathematically analogous to two-dimensional flow in a porous medium. Analysis which assumes continuity of pressure through the interface shows that a flow is possible in which equally spaced fingers advance steadily. The ratio λ = (width of finger)/(spacing of fingers) appears as the parameter in a singly infinite set of such motions, all of which appear equally possible. Experiments in which various fluids were forced into a narrow Hele-Shaw cell showed that single fingers can be produced, and that unless the flow is very slow λ is close to $\frac{1}{2}$, so that behind the tips of the advancing fingers the widths of the two columns of fluid are equal. When $\lambda = \frac{1}{2}$ the calculated form of the fingers is very close to that which is registered photographically in the Hele-Shaw cell, but at very slow speeds where the measured value of λ increased from $\frac{1}{2}$ to the limit 1.0 as the speed decreased to zero, there were considerable differences. Assuming that these might be due to surface tension, experiments were made in which a fluid of small viscosity, air or water, displaced a much more viscous oil. It is to be expected in that case that λ would be a function of $\mu U/T$ only, where μ is the viscosity, U the speed of advance and T the interfacial tension. This was verified using air as the less viscous fluid penetrating two oils of viscosities 0.30 and 4.5 P. A.

532.785

4792. GROWTH CONDITIONS FOR STABILITY OF A CELLULAR SOLID–LIQUID INTERFACE.
E.L.Holmes, J.W.Rutter and W.C.Winegard.
Canad. J. Phys., Vol. 35, No. 10, 1223-7 (Oct., 1957).

Samples of zone-refined lead containing various amounts of silver as solute were solidified under well-controlled conditions to study the transition from cellular to dendritic freezing as a function of composition, speed of freezing, temperature gradient in the melt during freezing, and crystallographic orientation of the solidifying crystal. A comparison of the results of this investigation with those of Tiller and Rutter (1956) on alloys of tin in lead shows that to a first approximation the onset of dendritic freezing under any given growth conditions occurs at a critical value of the average solute concentration in the liquid at the solid–liquid interface, independent of whether the solute present is tin or silver. A.

MECHANICS OF GASES

533.12 : 536.48 : 532.14

OPTICAL DETERMINATION OF THE DENSITY OF He^3. See Abstr. 4779

533.59 : 536.423.15

VAPOUR PRESSURE MEASUREMENT AT VACUUM PRESSURES. See Abstr. 3936

533.6.011 : 536.244

HYDRAULIC RESISTANCE FOR A HIGH-VELOCITY GAS FLOW. See Abstr. 3926

MOLECULAR THEORY OF GASES

533.7 : 536.23

4793. SOLUTION OF THE BOLTZMANN–HILBERT INTEGRAL EQUATION. II. THE COEFFICIENTS OF VISCOSITY AND HEAT CONDUCTION. C.L.Pekeris and Z.Alterman.
Proc. Nat. Acad. Sci. U.S.A., Vol. 43, No. 11, 998-1007 (Nov., 1957).

A simple gas of rigid spheres is treated using the same methods as in the previous part (Abstr. 1900/1956), and, assuming that the processes can be represented by a first-order perturbation of the distribution function, the equation is reduced to a fourth-order differential form. A correction is given for Boltzman's version in the momentum case. Good agreement is obtained with the results of Chapman–Enskog, but the perturbation is shown to be a poorer approximation for large values of momenta. P.Gray

533.7 : 537.311.1 : 537.56

4794. KINETIC AND POTENTIAL ENERGIES OF AN ELECTRON GAS. N.H.March.
Phys. Rev., Vol. 110, No. 3, 604-5 (May 1, 1958).

It is pointed out that the kinetic and potential energies of an electron gas may be obtained exactly in the high-density limit by using the virial theorem in conjunction with the results of Gell-Mann and Brueckner (Abstr. 6372/1957). For intermediate and low densities, the results obtained from Wigner's formula are also referred to, although for the intermediate region these are likely to be at best semiquantitative. A.

533.7 : 536

TABLES OF TRANSPORT PROPERTIES OF GASES. See Abstr. 3913

VIBRATIONS. ACOUSTICS

534.2

4795. PROPAGATION OF NONAXIALLY SYMMETRIC WAVES IN ELASTIC CYLINDRICAL SHELLS. R.M.Cooper and P.M.Naghdi.
J. Acoust. Soc. Amer., Vol. 29, No. 12, 1365-73 (Dec., 1957).

This paper, employing the equations of a previous paper (Abstr. 1912/1956), is concerned with the predictions of phase velocities and amplitude ratios, for nonaxially symmetric as well as purely torsional propagation of elastic waves in an infinite cylindrical shell. As in the previous case of axisymmetric propagation, comparison is made between the predictions of the two systems of equations and the conclusions are specified. A.

534.2

4796. ON WHETHER ELASTIC WAVE SURFACES POSSESS CUSPIDAL EDGES. M.J.P.Musgrave.
Proc. Cambridge Phil. Soc., Vol. 53, Pt 4, 897-906 (Sept., 1957).

Consideration of the direction of the normal at any point on a continuous sheet of a surface yields a sufficient condition for the existence of parabolic points on that sheet. This condition was used to derive some simple inequalities between elastic constants, whose fulfilment determines the existence of parabolic points upon the inverse surfaces of media of orthorhombic, tetragonal, cubic or hexagonal symmetry; in virtue of the polar reciprocal relation between inverse and wave surfaces, the existence of cusp points on the latter is thereby simultaneously established. It is also pointed out that conditions for external conical refraction may prevail in hexagonal media. A.

534.2 : 537.528

ELECTRO-ACOUSTICAL EFFICIENCY OF A SPARK DISCHARGE IN WATER. See Abstr. 4047

534.211

4797. SPHERICAL WAVES COUPLED TO A ONE-DIMENSIONAL WAVE GUIDE. J.E.White.
J. Acoust. Soc. Amer., Vol. 30, No. 1, 65-8 (Jan., 1958).

An approximate expression is derived for the disturbance in a one-dimensional waveguide resulting from an expanding spherical wave which is loosely coupled to the waveguide at all points along its length. For the case of a slender rod immersed in a fluid, curves are presented showing axial strain for three ratios of rod velocity to fluid velocity. A.

534.213 : 534.231

4798. WAVEGUIDE PROPAGATION OF SOUND FOR ONE CLASS OF INHOMOGENEOUS LAMELLAR MEDIA. Yu.L.Gazaryan.
Akust. Zh., Vol. 3, No. 2, 127-41 (1957). In Russian.

An integral representation is found for the field of a spherical harmonic point radiator situated in a medium in which the velocity of sound is varied according to Epstein's law. The case of waveguide propagation is investigated. A solution is found for waveguide propagation in an inhomogeneous semi-space with absolutely reflecting boundaries, for the waveguide axis lying in the semi-space boundary. C.R.S.Manders

534.213

4799. DIRECT OBSERVATION OF THE DISTORTION OF THE FORM OF INTENSE ULTRASONIC WAVES IN A LIQUID. V.A.Burov and V.A.Krasil'nikov.
Dokl. Akad. Nauk SSSR, Vol. 118, No. 5, 920-3 (1958). In Russian.

The method used by Zarembo et al. (Abstr. 1130/1957) involves complicated and cumbersome measurements of the absolute values of the harmonics' amplitudes. A method is described enabling the form of an intense (about 10 W/cm^2) ultrasonic wave propagated in a liquid to be directly observed in the megacycle frequency range. The emitter is a quartz plate 6 cm diameter, placed in transformer oil separated from the tested liquid (distilled water at about 20°C) by a half-wave glass plate. The receiver is another quartz plate (diameter 25 mm, diameter of silver coating 22 mm, resonance frequency 11.5 Mc/s) from which the signal was transmitted to the amplifier of a IO-4 oscillograph with a transmission band of 6-7 Mc/s. The accuracy of measurement is estimated at 10-15%. It was found that the wave, very nearly sinusoidal at a distance of 2 cm from the emitter (3.7 cm from the quartz plate), becomes increasingly distorted as the distance increases and acquires a serrated appearance. Results of graphical analysis of the curves show that the amplitude of the main wave (1st harmonic) decreases at first slowly and later more steeply, as the distance increases. The 2nd harmonic has a maximum value at about 10 cm distance. The wave can be considered to have stable form when the distance is 16 cm. It was also found that the distortion varies in time, probably owing to cavitation processes. F.Lachman

534.213

4800. PROPAGATION OF A SOUND PULSE IN A MEDIUM WITH A COMPLEX ELASTIC MODULUS. S.I.Tahsin.
Proc. Iraqi Sci. Socs, Vol. 1, 1-9 (1957).

A complex propagation constant is assumed with properties leading to relaxation phenomena. Two approximate methods are used to evaluate the integrals in the regions of no anomaly. The manner of the pulse build-up is established. It is found that a sonic pulse in a relaxing medium builds up exponentially at first and later assumes its oscillatory property. A.

534.222.2

4801. INTERACTION OF SHOCK WAVES WITH SMALL PERTURBATIONS. I. S.P.D'yakov.
Zh. éksper. teor. Fiz., Vol. 33, No. 4(10), 948-61 (1957). In Russian.

Interaction of oblique shock waves of arbitrary intensity with small perturbations was considered in a linear approximation in the framework of a two-dimensional stationary problem. The flow behind the shock wave was assumed to be supersonic. The general results were applied to the study of interaction with weak discontinuities, weak shock waves and with interfaces of two media that differ only slightly in their acoustical properties. A.

534.222.2

4802. INTERACTION OF SHOCK WAVES WITH SMALL PERTURBATIONS. II. S.P.D'yakov.
Zh. éksper. teor. Fiz., Vol. 33, No. 4(10), 962-74 (1957). In Russian.

Discussion of interaction of small perturbations with a shock wave of arbitrary intensity within the framework of a two-dimensional stationary problem in the case of subsonic flow behind the shock wave. A solution was found to the problem of the interaction of a weak and a weak-tangential discontinuity with the shock wave. In both cases, the weak-tangential discontinuity formed behind the shock wave possessed a logarithmic singularity. A

534.222.2 : 536.5

TEMPERATURE MEASUREMENTS OF SHOCK WAVES. See Abstr. 3952

534.222.2 : 532.161

THE ENERGY DISSIPATION AND IONIZATION OF INTERSTELLAR GAS BY SHOCK WAVES. See Abstr. 4625

534.23 : 532.7 : 539.19

4803. ULTRASONIC ANALYSIS OF MOLECULAR RELAXATION PROCESSES IN LIQUIDS. R.O.Davies and J.Lamb.
Quart. Rev. Chem. Soc., Vol. 11, No. 2, 134-61 (1957).

A review of the theory and application of ultrasonic loss experiments to investigate relaxation processes in liquids of the "quasi-chemical" type, e.g. the formation of rotational isomers in certain aldehydes and esters. Some account is also given of the vibrational relaxation observed in carbon disulphide, the variation o acoustic loss with composition in some liquid binary solutions (e.g. ethyl alcohol and water; benzene, chloroform and phenol in carbon tetrachloride) and effects — possibly due to dimerization — found in acetic and propionic acids. The thermodynamic theory is given in some detail and special attention is paid to the exact assumptions necessary in order to get information about ΔH_0 and ΔS_0 for a simple reaction mechanism in ideal solution. R.O.Davies

534.23 : 539.2

4804. THE ABSORPTION OF VERY HIGH FREQUENCY SOUND IN DIELECTRIC SOLIDS. S.Simons.
Proc. Cambridge Phil. Soc., Vol. 53, Pt 3, 702-16 (July, 1957).

A theoretical treatment is given of the absorption of longitudinally polarized sound in dielectric crystals of high symmetry, due to interaction with the thermal phonons. The Q-value for the absorption is calculated in terms of the deviation from Hooke's law, the result being applicable at low temperatures when the mean free path of the phonons is greater than the wavelength of the acoustic wave. The theory is applied to cubic crystals, and in particular to solid argon, where a minimum Q-value of about 10^8–10^9 is calculated. It is suggested that measurement of the absorption (at present somewhat beyond experimental techniques) would supply information on the deviation from linear elasticity, as well as providing a satisfactory verification of the basic interaction theory. The effect of isotopes, and, in more complicated structures, of optic modes, is shown to be negligible. A.

534.23 : 534.321.9

4805. A COMPARATIVE STUDY OF ULTRASONIC ABSORPTION IN $MnSO_4$ WITH $MgSO_4$ SOLUTIONS. G.S.Verma and S.K.Kor.
Proc. Phys. Soc., Vol. 72, Pt 1, 81-7 (July, 1958).

Ultrasonic measurements in $MnSO_4$ in the frequency range 1-6 Mc/s made by the optical method were compared with those in $MgSO_4$. The concentration behaviour of the absorption and the relaxation frequency, which was studied in great detail in the range 0.0025 to 1 molar, was compared with the earlier results in $MgSO_4$. The effect of the dielectric constant and the temperature on the absorption, relaxation frequency and the reaction rate support the dissociation hypothesis. A.

534.23 : 534.321.9

4806. ULTRASONIC ABSORPTION IN METALS.
A.I.Akhiezer, M.I.Kaganov and G.Ya.Lyubarskiĭ.
Zh. éksper. teor. Fiz., Vol. 32, No. 4, 837-41 (1957). In Russian.
English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 4, 685-8 (Nov., 1957).

The absorption coefficient for metals was computed. It is shown that if $\omega\tau \ll s/v$ (ω = frequency, τ = relaxation time, s = sound velocity, v = boundary electron velocity), the absorption coefficient is proportional to $\omega^2\tau$. For $\omega\tau \gg s/v$, the absorption is proportional to the first power of the frequency and does not depend on τ, i.e., it is independent of the temperature. A.

534.231

4807. THE PHENOMENON OF AMPLITUDE MODULATION IN INTERACTING ACOUSTIC WAVES. G.D.Mikhailov.
Akust. Zh., Vol. 3, No. 4, 376-8 (1957). In Russian.

In an earlier paper (Abstr. 3233/1954) the author made a study of the interaction of two progressive waves in a viscous medium. In the present paper the treatment is extended theoretically to the case of a bounded space between two infinite planes a known dis-

tance apart. The conclusions were checked by some experiments with vaseline as the viscous medium and some photographs are given showing how rapid is the fall-of with distance of the intensity of the combined frequency. C.R.S.Manders

534.232 : 537.228.1

4808. TRANSIENT PROCESSES IN PIEZO-VIBRATORS. P.V.Ponomarev.
Akust. Zh., Vol. 3, No. 3, 243-53 (1957). In Russian.

A quartz plate used as a radiator and also as a receiver is examined for pulses of arbitrary shape. A method is given for evaluating the basic parameters of the vibrator under pulse conditions. The radiated power, input and output impedances and sensitivity of the quartz plate are shown to differ markedly from those under steady-state conditions. C.R.S.Manders

534.232

4809. TESTS OF EXPERIMENTAL FERRITE ULTRASONIC RECEIVERS. I.P.Golyamina, A.D.Sokolov and V.I.Chulkova.
Akust. Zh., Vol. 3, No. 3, 288-90 (1957). In Russian.

Some preliminary tests of Ni—Zn ferrites used as magnetostriction acoustic receivers are reported. The $(\partial B/\partial \sigma)_H$ values of these ferrites are comparable with that for pure nickel, and furthermore these values can be varied over a wide range because Zn is soluble up to 70% in Ni. Graphs are given for frequency v. sensitivity and for specific sensitivity v. frequency of receiver units made of ferrites containing 0%, 20%, 30%, 50% Zn. Measurements were made also under pulse conditions. C.R.S.Manders

534.232 : 538.563

4810. THE EFFECT OF THE DIRECTIVITY OF A RECEIVER DEVICE ON THE MEAN INTENSITY OF A SIGNAL RECEIVED AS THE RESULT OF SCATTERING. V.A.Zverev.
Akust. Zh., Vol. 3, No. 4, 329-36 (1957). In Russian.

The author examines the effect of the shape of the receiver polar diagram upon variation with scattering angle of the intensity of received radiation. It is shown that to solve the scattered intensity problem it is sufficient to know the correlation function in the transverse direction for a distance not exceeding the dimensions of the receiver. C.R.S.Manders

534.241

4811. FREQUENCY DEPENDENCE OF ECHOES FROM BODIES OF DIFFERENT SHAPES. R.Hickling.
J. Acoust. Soc. Amer., Vol. 30, No. 2, 137-9 (Feb., 1958).

The echo returned by a body is known to be frequency dependent if the incident sound has wavelengths greater than or comparable with the over-all dimensions of the body. In this paper the results are presented of calculations which determine the echoes from the end-on aspect of a rigid prolate spheroid of fineness ratio 5/3, and from the beam-on aspect of an infinite circular cylinder, the incident sound consisting of plane monochromatic waves. These are compared with similar known results for a sphere. It is shown for these particular examples that the frequency dependence of the echo varies significantly with the shape of the body which returns the echo. It is suggested that bats use such properties in determining the form of their surroundings. A.

534.25

4812. SOME INVESTIGATIONS ON ACOUSTIC PRISMS. M.S.Narayanan.
J. Instn Telecomm. Engrs (New Delhi), Vol. 4, No. 2, 87-9 (March, 1958).

Two acoustic prisms were built, made of an obstacle array of brass strips, the strip-width corresponding to half the wavelength of sound at frequencies 10 and 3 kc/s respectively. The deviation of sound waves by these prisms for various frequencies was experimentally studied in a closed chamber with absorbing walls lined with felt wedges. The latter prism, of bigger strips, was constructed with a view to increase the resolution of frequencies which are very close together. The experimental results agree very well with the theory. Suitable spacing of the strips is also attempted to reduce the loss of intensity of sound during transmission. A.

534.26

4813. DIFFRACTION AND RADIATION OF SOUND WAVES IN LIQUIDS AND GASES. I. M.D.Khaskind.
Akust. Zh., Vol. 3, No. 4, 348-59 (1957). In Russian.

A general theory is presented of the hydrodynamic forces acting on a body during the diffraction and emission of sound waves in liquids and gases. It is shown that the theory developed by the author some time ago (Zh. éksper. teor. Fiz., Vol. 16, No. 7, 634-46, 1946) is actually in close agreement with the theory of hydrodynamic forces and momenta in the diffraction problem. C.R.S.Manders

534.26

4814. DIFFRACTION AND RADIATION OF SOUND WAVES IN LIQUIDS AND GASES. II. M.D.Khaskind.
Akust. Zh., Vol. 4, No. 1, 92-9 (1958). In Russian.

For Pt I, see preceding abstract. General equations are established in the quadratic approximation for the mean values of hydrodynamic forces and moments acting on a body during diffraction and emission of acoustic waves in liquids and gases. The general results are illustrated by concrete examples. C.R.S.Manders

534.26 : 535.42

4815. THE EFFECT OF FLUCTUATIONS ON THE DIFFRACTION IMAGE OF A FOCUSING SYSTEM. L.A.Chernov.
Akust. Zh., Vol. 3, No. 4, 360-65 (1957). In Russian.

General equations are obtained for determination of the mean distribution and the distribution of fluctuations in the diffraction image set up by a focusing system for an incident wave containing fluctuations. The general equations are investigated in the two special cases of large and small fluctuations. C.R.S.Manders

534.26 : 538.566

4816. EQUIVALENCE RELATIONS IN DIFFRACTION THEORY. S.N.Karp and W.E.Williams.
Proc. Cambridge Phil. Soc., Vol. 53, Pt 3, 683-90 (July, 1957).

Certail equivalence relationships between different problems occurring in diffraction theory of acoustic and electromagnetic waves are established. The method used is essentially Schwarz's principle of analytic continuation by reflection across a straight boundary. An explicit solution is also obtained by this method for a plane wave normally incident on a T-shaped structure. A.

534.26

4817. NOTE ON THE BACKSCATTERING OF SOUND FROM THE SEA SURFACE. E.O.LaCasce, Jr.
J. Acoust. Soc. Amer., Vol. 30, No. 6, 578-80 (June, 1958).

Experimental observations of backscattering from the sea surface are compared with computations based on an idealized surface. The scattering at angles near normal incidence is related to the theory of scattering from a sinusoidal surface. Scattering patterns for superposed sinusoids indicate the effect of ripples on backscattering. A.

534.321.9 : 541.182

4818. STUDY ON THE SEPARATION OF EMULSIONS AND SUSPENSIONS BY THE USE OF ULTRASONICS. F.Nesh and J.R.Andreotti.
J. Acoust. Soc. Amer., Vol. 30, No. 5, 478-9 (May, 1958).

A barium titanate transducer, delivering 20 W at approximately 25 kc/s, was used to coagulate rust powder and emulsified seawater in fuel oil. When a 2 in. steel screw attached to the transducer was submerged in the oil, contained in a 300 ml. beaker, coagulation and precipitation was effectively complete in 30 sec. Similarly, precipitation of rust particles and water droplets was obtained when the screw was soldered to the outside of a 1 in. steel pipe, through which the oil was pumped at 800 l/min. Large amounts of coagulated material adhered to the walls of the tube and suggestions are made for the use of baffles to enhance this effect and to obtain coagulation, separation and clearing in one step in a continuous process. J.Iball

534.321.9 : 537.228.1

4819. TRANSFORMING AN ULTRASONIC IMAGE INTO A VISIBLE ONE. V.G.Prokhorov.
Akust. Zh., Vol. 3, No. 3, 254-61 (1957). In Russian.

A (water) tank contains a radiator, specimen, focusing system to produce an acoustic image of the specimen. The latter is formed on a piezo-quartz plate let into the end of a cathode-ray tube. This end of the cathode-ray tube fits into the end of the tank. A second cathode-ray tube is arranged to draw its time-base voltages from the same unit as the first tube. An electrode set up behind the quartz plate picks up the secondary electron picture and is connected to the control grid of the second cathode-ray tube which will now produce an optical image of the acoustic image. Photographs of electron-acoustic tubes and of the visual images produced by the system are given. Sundry practical applications are considered covering a frequency range 4-10 Mc/s. C.R.S.Manders

534.321.9 : 535.324 : 535.42

THE REFRACTION AND DIFFRACTION OF LIGHT BY PROGRESSIVE WAVES OF FINITE AMPLITUDE. See Abstr. 3849, 3902

534.321.9 : 612.171

ULTRASONIC DOPPLER METHOD FOR THE INSPECTION OF CARDIAC FUNCTIONS. See Abstr. 4602

534.39 : 534.2

4820. STUDY OF THE PHOTO-DIFFUSION METHOD OF RENDERING ULTRASONIC FIELDS VISIBLE.
M.E.Arkhangel'skii and V.Ya.Afanas'ev.
Akust. Zh., Vol. 3, No. 3, 214-19 (1957). In Russian.

A cell is made by taking a U-shaped piece of Perspex and placing a plate of Perspex on each side of it. A developer solution and a piece of exposed photographic paper are placed in the cell, and the whole is placed in a tank of water and subjected to the action of ultrasonic waves falling normally on the paper. The effect of the ultrasound is to accelerate the rate of darkening of the paper. An object placed in the path of the ultrasonic waves will be shown in silhouette on the paper. The procedure can be used for defectoscopy. Results are given of a study of rate-of-darkening, with periods of irradiation of from 10 sec up to several minutes, due to 2 Mc/s waves. The effect of variation of incident radiation intensity upon the rate of blackening is also studied. A description is also given of the simple radiometer with which the intensity measurements were carried out. C.R.S.Manders

534.39 : 537.312.8

ACOUSTOMAGNETOELECTRIC EFFECTS IN METAL AND SEMICONDUCTOR FILAMENTS. See Abstr. 4036

534.39 : 541.135

SOME OBSERVATIONS ON THE DEBYE EFFECT IN ELECTROLYTES. See Abstr. 4505

534.6 : 519.272

4821. ANALYSIS OF A MULTIPLE RECEIVER CORRELATION SYSTEM. M.J.Jacobson.
J. Acoust. Soc. Amer., Vol. 29, No. 12, 1342-7 (Dec., 1957).

A theoretical study is made of an acoustic receiving system which contains a single correlator whose inputs are obtained from arrays of omni-directional receivers. Mathematical expressions are developed for the mean system output when the input arises from a distant localized signal source. In addition, two major advantages of multiple receiver correlation as compared to two receiver correlation are discussed in detail. These are improved directional patterns on narrow band signals and increased output signal-noise ratio resulting from the use of more than two receivers. A.

534.61 : 534.321.9

4822. AN INSTRUMENT FOR MEASUREMENT OF THE ABSOLUTE INTENSITY OF ULTRASONICS.
I.G.Mikhailov and V.A.Shutilov.
Akust. Zh., Vol. 3, No. 4, 379-80 (1957). In Russian.

The apparatus is a tongue-shaped Dewar vessel with a capillary side-tube sealed in. A shielded diaphragm fits on the open end of the Dewar vessel. A "working" liquid of large absorption coefficient and small viscosity, e.g. olive oil, fills the vessel. A sound incident on the diaphragm closing the vessel causes a pressure to be transmitted through the liquid. This produces a rise of the liquid in the capillary side tube. Measurements of the rate of rise of the liquid in the capillary enable measurements to be made over a range of ultrasonic intensities from 0.05 W/cm^2 to 30 W/cm^2. C.R.S.Manders

534.61

4823. BACKGROUND INFORMATION ON THE ACTIVITIES OF Z 24-W-18, SOUND LEVEL METERS. H.C.Hardy.
J. Acoust. Soc. Amer., Vol. 29, No. 12, 1330 (Dec., 1957).

This is the introductory paper to the Sound Level Meter Symposium which was held by the Acoustical Society of America in New York, May 23-25, 1957. The following 10 abstracts cover the papers and discussion presented at this symposium.

534.61

4824. HISTORICAL DEVELOPMENT OF THE SOUND LEVEL METER. H.H.Scott.
J. Acoust. Soc. Amer., Vol. 29, No. 12, 1331-3 (Dec., 1957).

This is reviewed with particular reference to the instrument's dependability, accuracy, size and weight. Future improvements mainly depend on the development of a suitable microphone. H.D.Parbrook

534.61

4825. MICROPHONES FOR SOUND LEVEL METERS.
B.B.Bauer.
J. Acoust. Soc. Amer., Vol. 29, No. 12, 1333-4 (Dec., 1957).

A new crystal (barium titanate) microphone is briefly described which gives better frequency, and polar responses, and control in manufacturing than the currently used microphone. Some problems of microphone design are indicated. H.D.Parbrook

534.61

4826. SOUND LEVEL METER TOLERANCES. G.W.Kamperman.
J. Acoust. Soc. Amer., Vol. 29, No. 12, 1334 (Dec., 1957).

These have been reduced in the proposed new American standar for sound level meters, and are essentially dictated by the improved characteristics of currently available and suitable microphones. H.D.Parbrook

534.61

4827. FILTER NETWORKS. C.L.Stevens.
J. Acoust. Soc. Amer., Vol. 29, No. 12, 1335 (Dec., 1957).

The loudness levels of noises are not in general measured by sound level meters. More significant information is obtained using octave, 1/2, or 1/3 octave filters and the instrument with the C network. A and B weighting networks might therefore be an allowable option in the proposed new American sound level meter standard. H.D.Parbrook

534.61

4828. CIRCUITS AND ATTENUATORS IN THE MODERN SOUND LEVEL METER. E.E.Gross.
J. Acoust. Soc. Amer., Vol. 29, No. 12, 1336 (Dec., 1957).

Their design to give an amplifier with good frequency response, low internal noise level and wide dynamic range, is briefly reviewed H.D.Parbrook

534.61

4829. VARIATION IN INDICATING INSTRUMENT DYNAMICS ATTAINABLE THROUGH APPROPRIATE DESIGN.
J.H.Miller and L.W.Pignolet.
J. Acoust. Soc. Amer., Vol. 29, No. 12, 1337-8 (Dec., 1957).

Moving coil indicating instruments with various dynamic characteristics (period 0.12 to 1.5 sec, and from undamped to twice critica damped) are briefly described. H.D.Parbrook

534.61

4830. RECTIFICATION IN THE SOUND LEVEL METER.
W.B.Snow.
J. Acoust. Soc. Amer., Vol. 29, No. 12, 1338-9 (Dec., 1957).

While the present American sound level meter standard calls for an r.m.s. indication, a true average indication, which differs little from the former for complex waves, would be more practicabl However, American and European opinion prefers retention of the r.m.s. characteristic, and in the proposed new standard this is the primary requirement, although the limits are set to include an average indication as acceptable. H.D.Parbrook

534.61

4831. PROPOSED SOUND LEVEL METER STANDARDS ON ENVIRONMENTAL INFLUENCES AND INTERNAL NOISE.
H.A.Thorpe.
J. Acoust. Soc. Amer., Vol. 29, No. 12, 1339 (Dec., 1957).

The proposed new American sound level meter standard prescribes a quantitative test for microphonics, requires the manufacturer to state the ambient temperature and humidity limits within which the meter will operate satisfactorily, and draws attention to the effects on the instrument of wind and of ambient magnetic and electric fields. H.D.Parbrook

534.61

4832. STATUS OF INTERNATIONAL STANDARDS ON SOUND LEVEL METERS. R.W.Young.
J. Acoust. Soc. Amer., Vol. 29, No. 12, 1340 (Dec., 1957).

A brief report is given of the Technical Committee 29 of the International Electrotechnical Commission which met in Paris 4-8 Feb 1957 to discuss an international standard for sound level meters. H.D.Parbrook

534.61

4833. DISCUSSION DURING SOUND LEVEL METER SYMPOSIUM.
J. Acoust. Soc. Amer., Vol. 29, No. 12, 1341 (Dec., 1957).

534.7

PHYSIOLOGICAL ACOUSTICS. HEARING. See also under "Medical science. Human physiology". Decimal classification 612.85

534.76

4834. BINAURAL LOCALIZATION [STEADY STATE SOUNDS] AND SPACE-FREQUENCY EQUIVALENCE. W.E.Kock.
J. Acoust. Soc. Amer., Vol. 30, No. 3, 222-3 (March, 1958).

534.784

4835. MODERN INSTRUMENTS AND METHODS FOR ACOUSTIC STUDIES OF SPEECH. G.Fant.
Acta polytech. Scand. Ph. 1 (No. 246/1958) 81 pp.

The techniques of studying speech by means of acoustic analysis

and synthesis are summarized with special emphasis on recent developments at the Royal Institute of Technology, Stockholm. The basic relations between articulation and speech wave are discussed, together with methods of spectrographic and oscillographic analysis, and the classification of the essential signal structure of speech sounds. Acoustic correlates to vowel quality, stress, juncture, and word accent are also discussed. Speech synthesis is described briefly, with special reference to instruments developed in Sweden. A.

534.79 : 612.85

4836. INVESTIGATION OF THE LOUDNESS SENSITIVENESS FOR RHYTHMIC NOISES. H.Niese.
Hochfrequenztech. u. ElektAkust., Vol. 66, No. 4, 115-25 (Jan., 1958). In German.

The author describes a study of the audibility of complex noises. The types of sound considered are: (1) sinusoidal tones amplitude-modulated and frequency-modulated, (2) rectangular modulated tones (square pulses), (3) impulse-modulated sinusoidal tones. It is shown that with low modulation frequencies all these periodic noise-forms evoke a large loudness impression from the subject under test. The paper is well illustrated by numerous oscillograms. The author concludes, however, that further investigation is required with a much greater number of test subjects. A.B.Wood

534.79 : 612.85

4837. SUGGESTION FOR A LOUDNESS MEASURING DEVICE TO GIVE CORRECT AURAL INDICATIONS OF "PEAKY" NOISE FORMS IN KNOWN SOUND-FIELDS. H.Niese.
Hochfrequenztech. u. ElektAkust., Vol. 66, No. 4, 125-39 (Jan., 1958). In German.

The author pays special attention to the subject of audibility of complex sounds, particularly to modulated sinusoidal waveforms, the modulation being also sinusoidal or rectangular or of other impulsive form. Many types of noise groups, illustrated by oscillograph records, are described. These noise groups contain varying and irregular amounts of amplitude and frequency modulation. The influence of sound-field form and its effect on the use of stereophonic microphones are discussed. See also the preceding and following abstracts. A.B.Wood

534.79 : 612.85

4838. SUBJECTIVE MEASUREMENTS ON THE INFLUENCE OF "PEAKINESS" OF BAND-PASS NOISE ON THE SENSATION OF LOUDNESS. H.Niese and J.Köhler.
Hochfrequenztech. u. ElektAkust., Vol. 66, No. 5, 150-60 (March, 1958). In German.

An investigation is described of the disturbing influence of peak content (peakiness) in narrow noise-bands. To produce the noise bands a white noise source and a selective amplifier were designed to give mean band frequencies f_m of 600, 1000 and 4000 c/s, and bandwidths Δf of 200, 100, 50, 20 and 10 c/s. Oscillograph records are reproduced showing the peakiness in each of these narrow frequency bands due to rapid amplitude fluctuations as a function of time. Spectral distributions are also shown on the basis of band noise (mean f_m of 1000 c/s and Δf 100 c/s) produced by frequency modulation. Using these devices a study was made of the loudness of complex noise. Reference is made to a paper by S.S.Stevens (Abstr. 195/1957). A.B.Wood

534.834

4839. NOISE FORMATION IN AN AIR DUCT WITH CAVITIES.
A.G.Munin and E.Ya.Yudin.
Akust. Zh., Vol. 3, No. 3, 291-2 (1957). In Russian.

Air was blown through a channel with air pockets along one side. The dimensions and number of these pockets were varied as well as the speed of the air through the channel. The mean air speed was recorded. Curves are given showing the noise under various conditions. A sharp upsurge in noise level governed by an eighth-power law seems to occur at an air speed of some 27 m/sec. No proportionality was found between the number of cavities and the amount of noise. C.R.S.Manders

OPTICS. RADIATION. SPECTRA

535-1

4840. INFRA-RED RADIATION. G.B.B.M.Sutherland.
Proc. Instn Elect. Engrs, Paper 2608, publ. July, 1958 (Vol. 105B, 306-15).

The fourty-eighth Kelvin lecture presented at the Institution of Electrical Engineers on 4th April, 1957.

535.1 : 517.3 : 538.56

INTERACTION OF RADIATION WITH A BODY. EVALUATION OF $\int Vdv/R^2$. See Abstr. 4162

535.13 : 537.56

4841. RADIATION OF A PLASMA IN A MAGNETIC FIELD.
B.A.Trubnikov.
Dokl. Akad. Nauk SSSR, Vol. 118, No. 5, 913-16 (1958). In Russian.

The radiation from a plasma, due to the spiral orbits of the electrons in the magnetic field, is considered in the limiting cases of non-relativistic and ultra-relativistic temperatures. The polarization and absorption is calculated and compared with astrophysical data in the two cases. S.F.Edwards

535.137 : 535.393

4842. STANDING LIGHT WAVES OF THE WIENER TYPE MADE VISIBLE BY ELECTRON-OPTICAL MEANS.
G.Möllenstedt, R.Speidel and W.Koch.
Z. Phys., Vol. 149, No. 3, 377-82 (1957). In German.

It was shown by Wiener in 1890 that a system of standing light waves can arise between the incident and reflected waves at the surface of a metal mirror. Such standing waves can be made visible by imaging the photoelectrons produced at the surface of the mirror with the aid of an electron emission microscope. T.Mulvey

535.231.4

4843. EMISSIVITY AT 0.65 MICRON OF SILICON AND GERMANIUM AT HIGH TEMPERATURES. F.G.Allen.
J. appl. Phys., Vol. 28, No. 12, 1510-11 (Dec., 1957).

For the purpose of making accurate optical pyrometer temperature measurements on silicon and germanium, the emissivities ϵ of etched single crystals were determined in vacuo from 1000°K to the melting point. The values of ϵ, accurate to ±10%, are tabulated against temperature. B.T.M.Willis

535.231.4 : 536.33

EFFECTIVE THERMAL EMITTANCE OF CYLINDRICAL CAVITIES. See Abstr. 3929

535.31 : 530.162

4844. SOME FUNDAMENTAL NOTES ON THE APPLICATION OF INFORMATION THEORY TO OPTICS. H.Schober.
Wiss. Z. Hochsch. Elektrotech. Ilmenau, Vol. 3, No. 3-4, 273-6 (1957). In German.

A brief account of information theory is given, with applications to electronics, acoustics etc. It is shown that optics can also be treated in the same way, and that this often leads to interesting new results. Typical examples are quoted: image assessment, television optics, physiological optics, etc. R.W.Fish

535.316/.318

4845. THE DESIGN OF PHOTOGRAPHIC OBJECTIVES OF THE TRIPLET FAMILY. I. THE DESIGN OF THE TRIPLET TYPE 111 OBJECTIVE. F.D.Cruickshank.
Austral. J. Phys., Vol. 11, No. 1, 41-54 (March, 1958).

A general study was made of the initial design of photographic objectives of the triplet family of objectives. A classification is suggested. The point of view is taken that it is convenient to regard the first two members of a triplet as constituting a compound corrector system to the rear positive member. An account is given of the design of the type 111 triplet objective to which any triplet may be reduced. A simple algebraic solution is then possible for the arrangement of the initial thin component system having any selected corrector power χ. It is shown that in triplets of unit power the only systems of any practical interest have corrector powers approximately in the range $-2 < \chi < 0.4$. In this range χ specifies the distribution of power between the two positive members of the triplet and is the variable which determines the spherical aberration when all other primary aberrations have been adjusted to desired small values. The effect of the residual values of the Petzval curvature and the chromatic aberration on the initial solution is discussed. The method provides a starting point for the development of the design of any objective having a basic triplet structure. A.

535.317.1

4846. MEASUREMENT AND ANALYSIS OF THE DISTRIBUTION OF ENERGY IN OPTICAL IMAGES.
R.L.Lamberts, G.C.Higgins and R.N.Wolfe.
J. Opt. Soc. Amer., Vol. 48, No. 7, 487-90 (July, 1958).

It is pointed out that a theoretical relation exists between the distribution of energy in the image of an edge (edge trace) and the distribution in the image of a line (line spread-function). Experimental data are presented in support of this relation and the method of determining these distributions experimentally is outlined. It is also pointed out that, since the spot diagram of a lens represents

the point spread-function, the line spread-function, needed for the foregoing procedure, can be found by mechanical summation of this diagram. An example is given to show that the edge trace of the finished lens can be thus predicted from the spot diagram. A.

535.317.1

4847. RELATIONSHIP BETWEEN THE SINE-WAVE RESPONSE AND THE DISTRIBUTION OF ENERGY IN THE OPTICAL IMAGE OF A LINE. R.L.Lamberts.
J. Opt. Soc. Amer., Vol. 48, No. 7, 490-5 (July, 1958).

The method of obtaining the sine-wave response of a lens, both theoretically and experimentally, is described, and it is shown that the line spread-function can be derived from the sine-wave response alone if the spread function is symmetrical. If the spread-function is not symmetrical, it can be computed from the sine-wave response only when the phase function is also known, and an experimental method of obtaining this function is described. The mathematical procedure for the reciprocal inversion of the spread function and the sine-wave response is confirmed experimentally. A.

535.317.23 : 522.24

EXPERIMENTAL STUDY OF THE DEFECTS OF THE IMAGE OF A STAR AS A FUNCTION OF THE DIAMETER OF THE OBJECTIVE USED [IN A TELESCOPE]. See Abstr. 4620

535.322.4 : 535.414

4848. INFRARED PHASE-CONTRAST REFRACTOMETER.
W.S.Rodney and E.Djurle.
J. Opt. Soc. Amer., Vol. 48, No. 6, 388-9 (June, 1958).

The optical and mechanical arrangement is discussed and a brief description of the experimental procedure is given. A value for (n - 1) of air of 0.000 268 34 was obtained for the 1.014 μ line of mercury. The standard deviation of the mean is ±0.7%. A.

535.325

4849. MEASUREMENTS OF THE DISPERSION OF AIR FROM 3651 TO 15 300 ANGSTROMS.
D.H.Rank, G.D.Saksena and T.K.McCubbin, Jr.
J. Opt. Soc. Amer., Vol. 48, No. 7, 455-8 (July, 1958).

The difference between the index of refraction for green mercury light and for 7 other mercury emission wavelengths from 15 300 A to 3651 A was measured using a Twyman–Green interferometer as a refractometer. A photoelectric method was used for the infrared determination. A method depending upon photography of interference fringes which were caused to appear crossing the lines in the mercury spectrum was used for the visible and ultraviolet measurements. The mean observed deviation of the measurements of (μ - 1) from the predictions of the Edlén formula was 1 part in 10^5. A.

535.325 : 533.72

4850. REFRACTIVITY OF GASES AND ITS USE IN CALCULATING VIRIAL COEFFICIENTS. H.M.Ashton and E.S.Halberstadt.
Proc. Roy. Soc. A, Vol. 245, No. 1242, 373-81 (1958).

Precision measurements of the refractive index of ethylene and neopentane over a pressure range from 0 to 1 atm, and a temperature range from 25° to 70° C, were made and used to calculate virial coefficients. Some measurements on air and n-hexane are also reported. Certain aspects of the use of the Rayleigh refractometer are discussed. A.

535.33

4851. THE INTENSITY OF SPECTRAL LINES. H.Triché.
C.R. Acad. Sci. (Paris), Vol. 245, No. 20, 1718-21 (Nov. 13, 1957). In French.

A quantitative discussion is given of the conditions in a discharge which control the intensities of spectral lines, with a view to application in spectrochemical analysis. R.W.Nicholls

535.33.03 : 621.373.4 : 621.327

4852. STABILIZED LIGHT INTENSITY AND SMALL LINE WIDTH USING U.H.F. EXCITATION. O.Björklund.
Ark. Fys., Vol. 13, No. 2, Paper 16, 185-98 (1958).

A u.h.f. oscillator for 330-2400 Mc/s with an R.C.A. 6161 triode, giving 120 W at 1000 Mc/s and used for excitation of discharge lamps, is described. The input is regulated by a feedback loop composed of a photomultiplier, an amplifier, and a power regulator. This gives precision stabilized light output. Wiring diagrams are shown. Several discharge-tube types are examined regarding light density, and a simple one recommended. Spectral line widths are examined in a Hulthén immersion grating spectrograph with a resolving power of 10^6. Reproductions are given of the lines Hg 5461 and 4358 A, and Cd 4678 A. A.

535.33.03

4853. THE GRAPHITE-CARBON ARC AS A STANDARD (SOURCE) OF INTENSE RADIATION. J.Euler.
S.B.Heidelberg. Akad. Wiss. (math. nat. Kl.), 1956-57, No. 4, 413-27. In German.

This arc provides an efficient and intense source of spectral continuum at a temperature of 3996° ± 15° K on the 1948 International Scale. Emission is effectively grey-body from 3000 A up to the infrared. D.R.Barber

535.33.07

4854. PERFORMANCE OF THE BECKMAN DK SPECTROPHOTOMETER. L.Cahn and B.D.Henderson.
J. Opt. Soc. Amer., Vol. 48, No. 6, 380-7 (June, 1958).

Comprehensive test specifications have been developed for the Beckman DK spectrophotometers, which may be applied, with appropriate modifications, to other recording photoelectric spectrophotometers. Average performance of a random sample of DK-2's, as defined by these tests, is calculated. A.

535.33.07 : 536.33

4855. INFLUENCE OF THE THERMAL RADIATION BACKGROUND ON SPECTROSCOPIC PROCESSES. B.I.Stepanov.
Optika i Spektrosk., Vol. 3, No. 1, 3-8 (1957). In Russian.

The relationship between emission and absorption is discussed and formulae relating number of excited molecules to radiation density derived. The influence of these processes on spectroscopic measurements in both the visible and infrared regions is pointed out. L.Bovey

535.33.07

4856. VACUUM GRATING SPECTROMETER FOR THE 0.7-3 μ REGION.
B.S.Neporent, K.P.Vasilevskiĭ, N.A.Lapina and V.A.Fyrsenkov.
Optika i Spektrosk., Vol. 3, No. 3, 289-93 (1957). In Russian.

The instrument is a Fastie–Ebert type with a 15 × 15 cm grating (300 lines/mm), 200 cm focal length mirrors and a PbS detector; 0.1 cm^{-1} resolving power is claimed. A fore-prism is included. A multiple reflecting cell allows path lengths up to 180 m to be used. A water-vapour record between 3966 and 3978 cm^{-1} is shown. L.Bovey

535.33.07 : 535.34.07

4857. THE RELATION BETWEEN THE SPEED OF SCANNING AND THE RESOLVING POWER OF A SPECTRAL INSTRUMENT. V.A.Nikitin.
Optika i Spektrosk., Vol. 4, No. 4, 523-5 (1958). In Russian.

Based on consideration of signal-to-noise relationships in the system, a summary is made of the best scanning speeds in cases where (1) slit widths are greater or less than the half-width of the spectral line examined, (2) the time-constant of the receiver is the determining factor. L.Bovey

535.331

4858. INTERFEROMETRIC MEASUREMENTS OF ISOTOPE SHIFTS IN MERCURY II AND MERCURY III WITH ENRICHED ISOTOPES. R.W.Shorthill and G.R.Fowles.
J. Opt. Soc. Amer., Vol. 48, No. 7, 459-60 (July, 1958).

Interferometric measurements of isotope shifts in the visible region of a number of lines of singly and doubly ionized mercury were made from sources containing enriched isotopes Hg^{198}, Hg^{200}, and Hg^{202}. In particular those lines having large isotope shifts were carefully studied. The results indicate a constant value, within experimental limit, of the ratio of the shift of Hg^{198}–Hg^{200} to that of Hg^{200}–Hg^{202}. A.

535.331

4859. THE EMISSION AND ABSORPTION SPECTRUM OF URANIUM. N.P.Penkin and S.É.Frish.
Optika i Spektrosk., Vol. 3, No. 5, 473-9 (1957). In Russian.

167 emission and 47 absorption lines were observed in a King-type furnace at temperatures between 2800° and 3000° K in the region from 2914 to 6555 A. No lines were found below 2914 A. The results are briefly discussed and are taken as general confirmation of the term classification of U I. (Abstr. 74/1947). L.Bovey

535.331

4860. EXCITATION OF ARC AND SPARK SPECTRA OF GADOLINIUM, DYSPROSIUM, ERBIUM AND THULIUM IN AN A.C. ARC. A.I.Akimov.
Optika i Spectrosk., Vol. 3, No. 6, 545-51 (1957). In Russian.

Spectra taken at the beginning and end of a "burn" on carbon electrodes in an a.c. arc are said to show enhancement of I and II

lines respectively. Tables are given for Gd (7 lines), Dy (53 lines), Tm (22 lines) and Er (56 lines) in which lines are assigned to the I or II spectra by this method. L.Bovey

535.331 : 537.525.5

4861. QUANTITATIVE EXAMINATION OF EMISSION SPECTRA OF SPARK DISCHARGES THROUGH A HIGH-PRESSURE MERCURY ARC. H.Meier.
Z. Phys., Vol. 149, No. 1, 40-61 (1957). In German.

The method consisted in discharging a 1 μF capacitor through a steady high-pressure mercury arc and recording the spectrum at the instant of strongest emission. Previous qualitative work by Göing (Abstr. 3538/1951) was extended by measuring the intensity distribution of the lines within 6500-3000 A region absolutely using a carbon arc with a temperature of 3995°K as a standard. The development of the continuum with increase in the spark potential between 300-1200 V and the conversion of the emission into absorption lines were examined more closely. Temperature determinations, using the method of Bartels (Abstr. 2717/1951), showed the temperature of the triplet state $6^3P_{0,1,2}-7^3S_1$/(4046, 4358, 5461 A) to increase from 9500°K for a spark potential of 300 V, to 1400°K at 550 V, reaching 20 000°K at 1200 V. A.E.D.Heylen

535.331

4862. ISOTOPE SHIFTS IN THE ATOMIC SPECTRUM OF PALLADIUM. H.G.Kuhn and A.G.Warner.
Proc. Roy. Soc. A, Vol. 245, No. 1242, 330-4 (1958).

The isotope shifts in the arc line 3405 A were measured, for all even isotopes of palladium, on enriched samples. A comparison of the shifts in palladium, cadmium and tin points to a systematic influence of the charge number on the isotope effect. A.

535.332 : 537.525.4

4863. MEASUREMENTS OF RELATIVE INTENSITIES OF SPECTRAL LINES IN THE EMISSION FROM HYDROGEN AND HELIUM SPARK CHANNELS. Tsui-Fang and J.D.Craggs.
J. Electronics and Control, Vol. 4, No. 5, 385-408 (May, 1958).

Spark discharges, in hydrogen, helium and He–H mixtures at atmospheric pressure, carrying 215 A rectangular-wave current pulses of 3.5, 0.8 and 0.5 μsec durations, were studied with a photomultiplier technique. Using a photomultiplier–amplifier–c.r.o. equipment in conjunction with a spectrometer, the relative intensities, and their time variations, of some of the prominent lines in the visible spectra emitted from the sparks were observed. The possible mechanisms of light emission in spark afterglow were discussed, and some tentative estimations of excitation temperatures in the spark channels were made. A.

535.332 : 537.525

4864. MULTIPOLE RADIATION FROM HIGH-CURRENT GAS DISCHARGES. S.Kaufman.
Nature (London), Vol. 180, 1345-6 (Dec. 14, 1957).

The possibility of detecting forbidden lines of astrophysical interest in the laboratory spectra of highly ionized gas is considered. It is shown that there is a reasonable chance of detecting some forbidden lines ($A > 1\ sec^{-1}$) of the ionized atoms of nitrogen, argon, neon and oxygen, using a prism spectrograph of medium aperture. On the basis that the populations of metastable ionized atoms in the ground configuration are governed by a Boltzmann distribution, electron temperatures of up to about 10^5 °K should be measurable. A check can possibly also be made of theoretical transition probabilities of the forbidden lines considered. D.R.Chick

535.332

4865. ABSOLUTE VALUES OF OSCILLATOR STRENGTHS FOR Cr, Mn AND Cu LINES. Yu.I.Ostrovskiĭ and N.P.Penkin.
Optika i Spektrosk., Vol. 3, No. 3, 193-201 (1957). In Russian.

The "hooks" method, in which an interference pattern between two beams, one passing through the metal vapour, is examined spectrographically, was used to determine f-values for the Cr, Mn and Cu resonance lines. Results obtained were Cr [f(3578 A) = 0.49, f(3593) = 0.39, f(3605) = 0.28, f(4254) = 0.15], Mn [f(4034 A) = 0.027, f(4033) = 0.040, f(4031) = 0.056] and Cu [f(3247 A) = 0.74, f(3274) = 0.38]. The results are compared with those of other workers and there is a marked disagreement with those of Huldt and Lagerquist (Abstr. 5001/1952) for Cr. L.Bovey

535.333 : 535.372

EMISSION SPECTRA OF THE THREE ISOMERIC FLUOROTOLUENES. See Abstr. 3892

535.333 : 523.67

4866. POSSIBLE REACTION MECHANISMS ASSOCIATED WITH EMISSION OF THE C_3 RADICAL IN LABORATORY AND ASTROPHYSICAL SOURCES. G.V.Marr.
Publ. Astron. Soc. Pacific, Vol. 70, 197-201 (April, 1958).

The intense continuous emission in the violet region of the spectrum associated with the C_3 bands in some laboratory sources is not observed in recent cometary spectra. To account for this discrepancy a discussion of some probable reaction mechanisms is presented. It is suggested that while the observations of the C_3 continuum in oxyacetylene flames could be the result of the formation of the electronically excited $C_3(\Sigma)$ radical by the reverse process to photodissociation, such a process is not likely to be the dominant mechanism for the formation of C_3 in comets. A.

535.337 : 537.562

4867. DEVIATIONS FROM THE HOLTSMARK PROFILE FOR BALMER LINES IN A PLASMA. G.Ecker.
Z. Phys., Vol. 149, No. 2, 254-66 (1957). In German.

Discusses corrections that have to be made to the Holtsmark statistical theory for inhomogeneous-field Stark-effect line-broadenings in electrical discharges, with reference to the Balmer lines of atomic hydrogen. Briefly, the above statistical theory should be corrected, it is suggested, by the introduction of a factor involving the ion and electron temperatures and allowance should be made in general for the effect of the electrons (ignored in the original Holtsmark analysis and its earlier applications to discharges). Theoretical analysis is given to describe both the above corrections and corresponding line profiles are shown. J.D.Craggs

535.338.333

4868. ISOTOPE SHIFT IN THE CERIUM SPECTRUM. L.A.Korostyleva.
Optika i Spektrosk., Vol. 3, No. 5, 536-44 (1957). In Russian.

A table of the shifts between Ce^{140} and Ce^{142} for 102 lines is given together with a short discussion on their relation to the term structure of Ce II. From measurements on a Ce^{136}–Ce^{138}–Ce^{140}–Ce^{142} mixture data were obtained for the shifts 138–140 in four lines. These results showed that $\Delta\nu(140-142)$ is nearly four times $\Delta\nu(138-140)$. L.Bovey

535.338.334 : 523.774

CALCULATION OF THE EQUIVALENT WIDTH OF BALMER LINES. See Abstr. 4670

535.34.07

4869. WIDE RANGE INFRARED ABSORPTION CELL. J.U.White and N.L.Alpert.
J. Opt. Soc. Amer., Vol. 48, No. 7, 460-2 (July, 1958).

A multiple traversal gas absorption cell was built for the measurement of strong and weak absorption bands in the same sample. By means of external adjustments its path length may be varied from 10 cm to 1 m, 10 m and intermediate values, with transmissions of 80%, 55%, and 32%, respectively. It has a volume of six litres and may be pressurized to 150 lb/in^2. A.

535.34.07

4870. METHOD AND APPARATUS FOR LONG-WAVE INFRARED SPECTROSCOPY. N.G.Yaroslavskiĭ.
Uspekhi fiz. Nauk, Vol. 62, No. 2, 159-86 (1957). In Russian.

A comprehensive survey, the physical principles of the various types of apparatus being particularly well illustrated. A table lists current laboratory spectrometers, their ranges of usefulness, basic design characteristic and resolving power. 78 references (about 10% of which are Russian). C.R.S.Manders

535.34.07

4871. HIGH-TEMPERATURE MOLECULAR BEAM MICROWAVE SPECTROMETER. A.K.Garrison and W.Gordy.
Phys. Rev., Vol. 108, No. 3, 899-900 (Nov. 1, 1957).

Microwave absorption measurements through hot gases at a wavelength of 3 mm were made by spraying molecular beams of the hot gases through the absorption cell. For KCl^{35} the transition frequencies (Mc/s): J = 12 → 13, v = 0 : 99 931.418. J = 12 → 13, v = 1 : 99 318.168 were found. The line-widths (~ 60 kc/s) are much less than those obtained with a conventional heated cell. R.W.Nicholls

535.343 : 535.37 : 539.2

4872. ATOMIC CENTRES OF ABSORPTION AND LUMINESCENCE IN ALKALI-HALIDE PHOSPHORS ACTIVATED BY HEAVY-METAL IONS AND THEIR FORMATION UNDER THE ACTION OF HIGH-ENERGY RADIATION. M.L.Kats.
Optika i Spektrosk., Vol. 3, No. 6, 602-9 (1957). In Russian.

The absorption spectra of NaCl, NaBr, KCl and KBr activated

by Ag, Ni and Sn were studied. Several methods for the introduction of impurities were used. Changes in absorption caused by X- and γ-radiation are shown in graphs. Fluorescent effects in crystals under the action of visible and ultraviolet light were also studied. There is a short discussion on the results. L.Bovey

535.343 : 539.2

4873. INTENSITY CALCULATION OF SOME OPTICAL ABSORPTION LINES IN HYDRATED MANGANOUS SALTS. S.Koide and M.H.L.Pryce.
Phil. Mag. (Eighth Ser.), Vol. 3, 607-24 (June, 1958).

The ligand field theory is applied to the hydrated manganous salts. The splitting of the degenerate levels of $^4A_{1g}$ and ^4E_g is first investigated, and then the intensities of the transition from the ground sextet $^6A_{1g}$ to these levels are calculated. The properties of the odd vibrations responsible for these transitions are also discussed. It is found that the calculated oscillator strengths are in good agreement with experiment if an appropriate model is used for the vibrations. A.

535.343

4874. THE ABSORPTION SPECTRA OF SILVER HALIDES, WITH ADDITION OF DIVALENT ANIONS, AT LOW TEMPERATURES. H.D.Koswig.
Z. Phys., Vol. 149, No. 2, 204-9 (1957). In German.

Absorption bands were measured for AgCl containing S or Se and for AgBr with O, S, Se or Te, at −180° C. A relation is given for the shift in absorption band. The energy of the maximum of the band is shown to depend on the lattice constant and ionic radius of the foreign anion. R.C.Seymour

535.343

4875. THE ABSORPTION SPECTRUM OF ELECTRON DEFECTS IN IONIC LATTICES. H.D.Koswig and O.Stasiw.
Z. Phys., Vol. 149, No. 2, 210-14 (1957). In German.

The equation (see the preceding abstract) giving the shift in absorption band due to foreign anions in silver halides, is shown to account also for absorption bands due to colour centres in alkali halides. It is concluded that this is a more general relation than that of Mollwo (1931) and gives more information on the nature of the absorbing centres. R.C.Seymour

535.343 : 535.37

4876. STUDIES OF MOLECULAR CRYSTALS AT LOW TEMPERATURES. A.F.Prikhot'ko.
Optika i Spektrosk., Vol. 3, No. 5, 434-56 (1957). In Russian.

A review article on studies at liquid-air and liquid-hydrogen temperatures. Apparatus to hold the crystals is discussed. The main sections of the paper deal with luminescence and absorption spectra of organic molecular crystals as well as the dispersion of light in them. There is an extensive series of references to both theoretical and experimental Russian work, including ten relevant dissertations. L.Bovey

535.343

4877. HIGH-RESOLUTION ABSORPTION SPECTRA OF NITROGEN IN THE VACUUM ULTRAVIOLET. P.G.Wilkinson.
Astrophys. J., Vol. 126, No. 1, 1-9 (July, 1957).

The absorption spectrum of the Lyman–Birge–Hopfield system ($a^1\Pi_g - X^1\Sigma_g^+$) of nitrogen has been obtained for the first time under high resolution. The 0-0, 1-0, and 2-0 bands are analysed, and the results on the ground state show excellent agreement with high-resolution Raman data. A critical analysis (and recomputation) of recent emission data on the L.B.H. and b'-X bands shows substantial agreement with the present investigation and produces small changes in the molecular constants (B_e = 1.6155 cm^{-1}, a_e = 0.011780 cm^{-1} for a $^1\Pi_g$; B_e = 1.9987, a_e 0.01781 cm^{-1} for $X^1\Sigma_g^+$). The experimental methods used in the present work and the treatment of the data are discussed, with special attention to a comparison of the experimental accuracies with the emission and the Raman data. A.

535.343 : 539.21

4878. EFFECT OF NEUTRON IRRADIATION ON INFRARED ABSORPTION IN SILICON. W.G.Spitzer and H.Y.Fan.
Phys. Rev., Vol. 109, No. 3, 1011-12 (Feb. 1, 1958).

Three new effects are reported: (1) production of an absorption band at 20.5 μ, insensitive to temperature; (2) an absorption band at 3.9 μ, becoming more pronounced after annealing; (3) a general decrease of infrared transmission after annealing. The first effect is attributed to the activation of normal optical modes by lattice defects, the second to the production of a new type of centre by heat-treatment, and the third to impurities. B.T.M.Willis

535.343

4879. THE INFRA-RED ABSORPTION SPECTRA OF α-QUARTZ BETWEEN 4 AND 15 MICRONS. B.D.Saksena.
Proc. Phys. Soc., Vol. 72, Pt 1, 9-16 (July, 1958).

The infrared absorption spectra of α-quartz and vitreous quartz between 4 and 15 microns are given and values of the absorption coefficients were calculated with the help of published reflectance data. Certain results are stated which are not in agreement with the earlier classification of the bands on the basis of point-group D_3. A

535.343

4880. HYPERFINE STRUCTURE IN THE MICROWAVE SPECTRUM OF WATER. I. QUADRUPOLE COUPLING IN DEUTERATED WATER. D.W.Posener.
Austral. J. Phys., Vol. 10, No. 2, 276-85 (June, 1957).

Measurement of hyperfine structure in the microwave spectrum of D_2O gives $(eqQ)_{OD}$ = +353 ± 4 kc/s for the quadrupole coupling constant of the deuteron in the direction of the OD bond, and the corresponding electric field gradient is $q_{OD} = \langle \partial^2 V/\partial \xi^2 \rangle_{av}$ = (1.78 ± 0.02) × 10^{15} e.s.u. The observed hyperfine splitting of HDO is not accounted for by a simple quadrupole interaction and appears to require relatively large magnetic interaction terms for a complete description. A.

535.343.9 : 535.375.5 : 539.2

4881. RAMAN SPECTRA OF CRYSTALS CONTAINING COMPLEX IONS. A.I.Stekhanov.
Optika i Spektrosk., Vol. 3, No. 2, 143-57 (1957). In Russian.

More lines than previously reported were observed in the Raman spectra of $CaCO_3$ (calcite) and $BaSO_4$ (barytes). These data and other workers' infrared results are discussed and interpreted as lattice and ion vibrations. The difference in spectra from crystals at 20° C and 500° C show the presence of second-order Raman lines and these are discussed in connection with acoustic and optical modes of vibration. L.Bovey

535.343.9 : 535.375.5 : 535.43

4882. THE RATIO OF INTENSITIES OF RAMAN AND RAYLEIGH LINES OF CARBON TETRACHLORIDE. J. Brandmüller and H.Schrötter.
Z. Phys., Vol. 149, No. 2, 131-52 (1957). In German.

The ratio of intensities of Raman and Rayleigh lines of liquid CCl_4 was measured photoelectrically. Observed intensities were reduced to standard intensities by the method of Bernstein and Allen (Abstr. 4557/1955). Intensity ratios were recalculated for corresponding values in gaseous CCl_4. From the measured intensities and degrees of depolarization, the trace and anisotropy of the polarizability tensor could be calculated. R.C.Seymour

535.345

4883. FUNDAMENTAL ABSORPTION OF BARIUM OXIDE FROM ITS REFLECTIVITY SPECTRUM. F.C.Jahoda.
Phys. Rev., Vol. 107, No. 5, 1261-5 (Sept. 1, 1957).

The reflectivity spectrum of single crystals of barium oxide, cleaved in vacuum, was measured as a function of temperature. The Kramers–Kronig integral relation was applied to derived the spectral dependence of both the absorption constant and index of refraction in the fundamental absorption region. The absorption compares favourably with results of previous thin-film transmission measurements and confirms the intrinsic nature of the multiple structure, recently explained by Overhauser as resulting from spin–orbit interaction in exciton creation. Large time-dependent changes of the reflectivity spectrum was observed even in a vacuum of 10^{-7} mm Hg at liquid-nitrogen temperature and are interpreted as interference effects from a growing surface layer of $Ba(OH)_2$, formed with a diffusion-limited rate of growth. A.

535.345 : 539.2

THEORY OF EXCITON ABSORPTION OF LIGHT. See Abstr. 4408

535.345 : 539.2

"INTRAZONAL" MECHANISM FOR LIGHT ABSORPTION IN SOLIDS. See Abstr. 4409

535.36 : 535.347

4884. LIGHT PROPAGATION IN ABSORBING CRYSTALS POSSESSING OPTICAL ACTIVITY. S.Pancharatnam.
Proc. Indian Acad. Sci. A, Vol. 46, No. 4, 280-302 (Oct., 1957).

A light beam in an absorbing crystal may be considered as travelling under the superposed effects of linear birefringence, linear dichroism, optical rotation and circular dichroism. The theory of the propagation is developed by a geometrical method which utilizes the properties of the Poincaré sphere (Jerrard,

Abstr. 9143/1954). For any general direction of propagation the theory gives the states of polarization of the waves in the crystal and their velocities and absorption coefficients. The case of biaxial media with negligible or no circular dichroism is considered in detail. (See Pancharatnam, Abstr. 9574/1955, 2789/1956).

H.G.Jerrard

535.36 : 535.347

4885. THE OPTIC INTERFERENCE FIGURES OF AMETHYSTINE QUARTZ. I. S.Pancharatnam.
Proc. Indian Acad. Sci. A, Vol. 47, No. 4, 201-9 (April, 1958).

Amethystine quartz belongs to the class of biaxial media possessing both pronounced pleochroism and optical rotatory power. This paper discusses the interference figures displayed in convergent light by an amethystine sector. The wavelengths used, blue and red, lie practically outside the absorption band. In blue light the interference figures are characteristic of a transparent biaxial crystal possessing the rotatory power of quartz. In red light the axial angle is larger and effects due to weak linear dichroism are also exhibited. The interference figures differ considerably from those displayed both by inactive absorbing crystals and active transparent crystals but can be explained by an earlier theory (see preceding abstract). Ten interference figures are reproduced. H.G.Jerrard

535.36 : 535.347

4886. THE OPTIC INTERFERENCE FIGURES OF AMETHYSTINE QUARTZ. II. S.Pancharatnam.
Proc. Indian Acad. Sci. A, Vol. 47, No. 4, 210-29 (April, 1958).

For Pt I, see preceding abstract. Twenty-four interference figures are reproduced for a wavelength 5890 A lying in the absorption band and for which the linear dichroism of amethystine quartz is appreciable. In this case the effects of dichroism predominate so that the existence of optical rotatory power is only indirectly made manifest by the exceptional nature of the observed phenomena. These phenomena are described by the author who states that they confirm his earlier theory (see two preceding abstracts). H.G.Jerrard

535.37

4887. ON THE IDENTIFICATION OF LUMINESCENT COMPLEXES OF CADMIUM IODIDE AND LEAD IODIDE.
G.Monod-Herzen and Nguyen Chung-Tu.
C.R. Acad. Sci. (Paris), Vol. 246, No. 15, 2247-50 (April 14, 1958). In French.

The solubility of PbI_2 in CdI_2 was determined between 15 and and 65°C. Between 15 and 50°C the ratio PbI_2/CdI_2 varies between 1.2×10^{-4} and 6.3×10^{-4}, giving maximum luminescence output. Above 50°C, luminescence increases with activator concentration up to 1%. J.Franks

535.37 : 539.2 : 535.343

ATOMIC CENTRES OF ABSORPTION AND LUMINESCENCE IN ALKALI-HALIDE PHOSPHORS. See Abstr. 4872

535.371

4888. ENERGY TRANSFER IN ORGANIC SYSTEMS. I. PHOTOFLUORESCENCE OF TERPHENYL–TOLUENE SOLUTIONS.
J.B.Birks and A.J.W.Cameron.
Proc. Phys. Soc., Vol. 72, Pt 1, 53-64 (July, 1958).

The fluorescence quantum intensities of normal and oxygen-free solutions of para-terphenyl in toluene were measured as a function of concentration c and of excitation wavelength λ from 2200 A to 3300 A. The absorption spectra of toluene and terphenyl were observed. The energy transfer coefficient f from excited toluene molecules to terphenyl molecules has thus been obtained. The value of f is found to depend on λ. For a given c, $f = f_1$ in region 1 (λ = 2500-2650 A), $f = f_2 > f_1$ in region 2 (λ = 2200-2350 A), and $f_2 > f > f_1$ for intermediate λ. Regions 1 and 2 correspond to the first and second excited electronic singlet states of toluene. The solvent–solute energy transfer from the second excited state, which occurs in approximately 10^{-11} sec, competes efficiently with conversion to the first excited state of toluene. A.

535.371

4889. A NOTE ON THE PROBLEM OF "SELF ACTIVATION" IN ZnS. E.A.Schwager and A.Fischer.
Z. Phys., Vol. 149, No. 3, 345-6 (1957). In German.

The "self-activated" fluorescence of zinc sulphide phosphors is attributed to a change in the equilibrium conditions for Schottky defects dependent on preparation conditions. G.F.J.Garlick

535.371 : 537.312.5

FLUORESCENCE OF AROMATIC HYDROCARBONS. See Abstr. 4025

535.376

4890. SENSITIZATION WITH TRACES OF GOLD, OF MATERIALS SHOWING AN ELECTRIC FIELD INTENSIFYING EFFECT. G.Destriau.
C.R. Acad. Sci. (Paris), Vol. 245, No. 22, 1913-16 (Nov. 25, 1957). In French.

Traces of gold, 10^{-6} to 5×10^{-6} by weight, increase the intensifying ratio and brightness of mixtures of Mn activated CdS and ZnS under X-radiation, on application of an electric field. This effect is greatest for mixtures containing equal quantities by weight of CdS and ZnS. J.Franks

535.376

4891. ORGANIC-GLASS SCINTILLATORS.
J.W.Downs and F.L.Smith.
Nucleonics, Vol. 16, No. 3, 94-6 (March, 1958).

Triphenyl-p-biphenylylsilane and phenyltri-p-biphenylylsilane have been tested as scintillators. They are transparent, easily moulded and give a pulse 60% as large as single anthracene crystals. They are soluble in various organic solvents, forming clear scintillating liquids. R.D.Smith

535.376 : 539.1.07

4892. THE FLUORESCENT DECAY OF CsI(Tl) FOR PARTICLES OF DIFFERENT IONIZATION DENSITY.
R.S.Storey, W.Jack and A.Ward.
Proc. Phys. Soc., Vol. 72, Pt 1, 1-8 (July, 1958).

New measurements of the decay of the fluorescence produced in CsI:Tl were made for different particles. The detailed shape of the decay is found to depend on the average ionization density ρ. The lifetimes τ of the main components are 0.425 ± 0.025 μsec for 4.8 MeV alpha-particles, 0.52 ± 0.01 μsec for 2.2 MeV protons, 0.595 ± 0.02 μsec for 8.6 MeV protons and 0.70 ± 0.025 μsec for 0.66 MeV electrons. The variation of τ and ρ is very similar to that observed by others for the variation of τ with temperature for alpha-particles, which suggests that the former may be explained in terms of variations in the effective local temperature. It is shown that the differences in τ are sufficient to allow a single crystal detector to be used in experiments where particle type as well as energy determination are required. A.

535.376

4893. REINFORCEMENT BY ELECTRIC FIELDS OF THE SENSITIVITY TO X-RAYS OF CERTAIN LUMINESCENT PRODUCTS, AND PHOTOELECTROLUMINESCENCE. G.Destriau.
C.R. Acad. Sci. (Paris), Vol. 245, No. 21, 1797-800 (Nov. 18, 1957). In French.

The luminescence of ZnCdS : Mn under X-rays is enhanced by a simultaneous a.c. field, and the effect is similar whether the field is in phase with the X-ray pulses, or 90° out of phase. With ZnS : Ag an extinction replaces the enhancement, though only if the X-rays and a.c. field are in phase. These results conflict with the mechanism of photoelectroluminescence advanced by Cusano and Williams (Abstr. 4232/1957). Wave forms of the luminescence are shown. S.T.Henderson

535.376 : 621.38

4894. THE EFFECT OF ELECTRIC FIELDS ON SCINTILLATIONS IN CRYSTALLINE ZINC SULPHIDE. G.F.Alfrey and K.N.R.Taylor.
J. Electronics and Control, Vol. 4, No. 5, 417-24 (May, 1958).

The effects of both static and alternating electric fields on scintillations produced by alpha particles in zinc sulphide were examined. The results indicate that in electroluminescent crystals the brightness is reduced when the alpha particles are incident on the negative electrode. A change of barrier thickness with frequency was estimated from the results. The variation is interpreted as a change in dielectric constant with frequency. The results are in good agreement with earlier work and are supported by observations of the electroluminescence threshold voltage. A.

535.376

4895. ELECTROLUMINESCENCE. F.Přibyl.
Slaboproudý Obzor, Vol. 19, No. 4, 239-46 (1958). In Czech.

A review paper dealing with the physics of electroluminescence and some of its practical applications. The energy model of a luminescent crystal is explained and the mechanism of electroluminescence is discussed in some detail. It is pointed out that ZnS, CdS, ZnSe, CdSe and ZnO possess good luminescent properties, and the technology of the preparation of these materials is outlined. The phenomenon of electroluminescence finds applications in lighting (luminescent tubes), image converters, picture amplifiers, electroluminescent amplifiers and, in future, television display tubes. 16 references. R.S.Sidorowicz

535.39 : 541.183

4896. EXPERIMENTAL DETERMINATION OF THE REFLECTION, TRANSMISSION AND ABSORPTION FACTORS OF "SELF-COMPRESSED" THIN FILMS OF BLUE ORGANOL. R.Rinaldi, R.Boyer and Y.Bernard.
C.R. Acad. Sci. (Paris), Vol. 245, No. 25, 2239-41 (Dec. 16, 1957). In French.

Experiments are described for studying the optical properties of stratified monomolecular layers formed by an organic absorbent, the layers used being thin "auto-compressed" films of blue organol which is 1-methylamino-4-paratoluilamino-anthraquinone. The experiments described were done on crystals purified by chromatography. Results are given in the form of a curve for wavelength region over the whole visible spectrum. Measurements are reported for films numbering from 5 to 40 strata. Measurements show that this material has anti-reflection properties for a wavelength of 4250 A. S.Tolansky

535.39 : 681.142

4897. A MECHANICAL VERSION OF THE SMITH CHART. J.E.Knowles.
J. sci. Instrum., Vol. 35, No. 7, 233-7 (July, 1958).

This modification was devised for the purpose of computing the transmission characteristics of non-absorbing optical or electrical multi-element filters. The conventional printed chart is replaced by a system of mechanical linkages, together with a spiral computing element. The computer is more accurate, faster and less laborious to use than the orthodox chart. A.

535.393 : 535.417

4898. A NEW INTERFEROMETRIC METHOD TO DETERMINE OPTICAL CONSTANTS OF METALS. I.N.Shklyarevskiĭ.
Optika i Spektrosk., Vol. 3, No. 6, 638-40 (1957). In Russian.

The method involves measurement of the difference in the phase-shift of the π and σ components when light is transmitted by interferometer plates covered by the material under investigation. L.Bovey

535.417

4899. ON THE APPLICATION OF A THIN LUMMER–GEHRCKE PLATE. L.A.Fedin.
Astron. Zh., Vol. 34, No. 1, 135-8 (1957). In Russian.

It is shown, using a conventional argument, that the resolving power of a thin (0.2 mm) Lummer–Gehrcke plate as calculated by Merkulov (Astron. Zh., Vol. 23, 149, 1946) is incorrect. The value given by Merkulov is 6.1×10^7, whereas the correct value is 2.43×10^4. This is of the order of the resolving power of a prism spectrograph. The same applies to the dispersion of the plate. The spectral range of the plate is only 10-15 A and there are serious constructional difficulties. On balance, the thin Lummer–Ghercke plate is of doubtful value. S.Chomet

535.417

4900. FRINGE SHARPENING IN DIVIDED BEAM INTERFEROMETERS. W.Primak.
J. Opt. Soc. Amer., Vol. 48, No. 6, 375-9 (June, 1958).

The development of sharpened fringes in long path length interferometers (like the Twyman–Green, Mach–Zehnder, and series) by intensity and by multiple reflection is described. The cause of the extreme localization of some of the multiple-reflection fringe patterns is discussed. A.

535.417 : 531.715

4901. INTERFEROMETRIC MEASUREMENTS IN METROLOGY. M.F.Romanova.
Optika i Spektrosk., Vol. 3, No. 5, 457-72 (1957). In Russian.

This review article gives accounts of work on (1) the determination of the wavelength of the standard Cd line; (2) measurement of 1 m length standards; (3) the wavelength of the Cd red line for the isotopes 112, 114, and 116; and (4) a method for finding the velocity of light. Results are given in each section with diagrams of the apparatus used. L.Bovey

535.417

4902. ON THE FLUCTUATION RESOLUTION LIMIT OF AN OPTICAL MODULATION INTERFEROMETER. S.M.Kozel.
Zh. éksper. teor. Fiz., Vol. 32, No. 4, 738-49 (1957). In Russian. English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 4, 609-17 (Nov., 1957).

A theoretical model of a modulation optical interferometer designed to measure the angular dimensions of a source is considered. Expressions are obtained for the fluctuation limits of sensitivity and precision. Experiments are described which indicate that the theoretical sensitivity and precision limits can be obtained in practice. The influence of atmospheric perturbations in a stellar modulation interferometer is estimated. A.

535.417 : 537.226.2 : 539.232

DETERMINATION OF PROPERTIES OF TANTALUM OXIDE FILMS FROM INTERFERENCE COLOURS. See Abstr. 4464

535.42 : 534.321.9

4903. DIFFRACTION OF LIGHT BY ULTRASONIC WAVES OF LARGE AMPLITUDE. I.G.Mikhailov and V.A.Shutilov.
Akust. Zh., Vol. 3, No. 2, 203-4 (1957). In Russian.

With a light beam crossing an ultrasonic field a sharp asymmetry of the diffraction picture was observed for large amplitudes of the ultrasonic oscillations. The intensity of the diffraction lines to one side of the central maximum differs from that on the other for lines of the same order. The intensity of the lines is greater in the direction of propagation of the waves. Records were obtained for various sound intensities and for various distances between the quartz and the light beam crossing the ultrasonic field. It is suggested that the effect is due to a distortion of the shape of the ultrasonic wave with the formation of shock waves, the possibility of occurrence of which was shown by Zarembo (Abstr. 1130/1957). C.R.S.Manders

535.42 : 534.321.9

4904. ON THE PHASE GRATING IN SUSPENSIONS CROSSED BY ULTRASOUNDS. F.Porreca.
Nuovo Cimento, Vol. 6, No. 4, 917-24 (Oct., 1957).

These gratings were shown to persist for a short time after the cessation of the sound (Abstr. 5250/1957). Measurements on the diffraction pattern from a starch solution (0.08 g/l), previously traversed by a standing sound wave (1.8 Mc/s), suggest a spatial variation of the solution refractive index of a "sinusoidal positive semi-wave" form. H.D.Parbrook

535.42 : 534.26

EFFECT OF FLUCTUATIONS ON THE DIFFRACTION IMAGE OF A FOCUSING SYSTEM. See Abstr. 4815

535.434 : 532.7 : 534.22

4905. CERTAIN PROBLEMS OF MOLECULAR SCATTERING OF LIGHT IN LIQUIDS. I.L.Fabelinskiĭ.
Uspekhi fiz. Nauk., Vol. 63, No. 2, 355-410 (1957). In Russian.

A review article stressing the contributions of the late G.S.Landsberg to this topic. The article deals with: theory of molecular scattering of light in pure liquids, absolute measurements of molecular scattering of light in liquids and comparison with theoretical values, dispersion of sound, polarization of the Mandel'shtam–Brillouin component in liquids, studies on the fine structure of a scattered optical line. 122 references. C.R.S.Manders

535.434 : 539.19

LIGHT SCATTERING AND STATISTICAL SHAPE OF STREAMING FREELY FLEXIBLE LINEAR MACROMOLECULES. See Abstr. 4400

535.55

4906. DOUBLE REFRACTION PHENOMENA IN QUANTUM FIELD THEORY. M.J.Stephen.
Proc. Cambridge Phil. Soc., Vol. 54, Pt 1, 81-8 (Jan., 1958).

It is shown that the phenomena of double refraction — optical activity, Faraday rotation, Kerr effect, etc. — may be treated as scattering problems in quantum field theory. An expression for the scattering cross-section of an atom or molecule for photons may be easily obtained and from this expression,using the idea of Stokes operators, equating their expectation values to the classical Stokes parameters, the usual quantum-mechanical expressions for optical activity, etc. may be obtained. This approach does not require the ideas of refractive index or polarization of the medium, and emphasizes what are the actual observables in these experiments. A.

535.557 : 534.39

4907. ACOUSTIC BIREFRINGENCE. METHODS OF MEASUREMENT, STUDY OF DISPERSION. J.Badoz.
Ann. Phys. (Paris), Sér. 13, Vol. 3, No. 1-2, 33-87 (Jan.-Feb., 1958). In French.

Theories of birefringence are reviewed. An improved apparatus using a photomultiplier is described. While the measured dispersion in ethyl cinnamate and benzyl benzoate agrees with the theory of Servant (Abstr. 6419/1950), this is not so for a solution of polystyrene in benzene. The method permits determination of the relaxation times for the phenomenon in solutions of high polymers. H.D.Parbrook

535.7

PHYSIOLOGICAL OPTICS. VISION. See under "Medical science. Human physiology". Decimal classification 612.84

HEAT

536.21 : 539.2

4908. THERMAL RESISTIVITY OF POINT DEFECTS. A.M.Toxen.
Phys. Rev., Vol. 110, No. 2, 585-6 (April 15, 1958).

By analysing the experimental results for a wide range of materials it is shown that the point defect resistivity varies more slowly with the degree of crystal disorder than is predicted by existing theories. E.P.Wohlfarth

536.212

4909. THERMAL RESISTANCE DUE TO ISOTOPIC MASS VARIATION. P.G.Klemens.
Proc. Phys. Soc. A, Vol. 70, Pt 11, 833-6 (Nov., 1957).

The theory of thermal resistance due to isotopic mass variation was tested using copper—gold alloys. At temperatures above 40°K the lattice thermal conductivity was of the form 1/CT, where C is a constant and T the temperature, indicating that the thermal resistance is due to point imperfections (gold atoms) and that C depends primarily on the mass difference of gold and copper atoms. For the alloy with 7.5% gold the theoretical value of C was 1.7 times the observed value, and for the 16.5% alloy it was 2.2 times larger. B.T.M.Willis

536.212.2 : 537.311.31

4910. LATTICE THERMAL CONDUCTIVITY OF SOME COPPER ALLOYS. W.R.G.Kemp, P.G.Klemens and R.J.Tainsh.
Austral. J. Phys., Vol. 10, No. 4, 454-61 (Dec., 1957).

The thermal and electrical conductivities of three copper-zinc alloys annealed at high temperatures, and of two copper-gold alloys, were measured over a wide range of low temperatures, and their lattice component of thermal conductivity was deduced in the range from 2° to 90°K. It appears that the high lattice thermal resistance at liquid helium temperatures previously found in copper-zinc alloys is a function of solute content rather than of concentration of conduction electrons and that this resistance can be reduced by high-temperature annealing. This extra resistance is thus due to dislocations locked in stable arrays by the presence of solute atoms, and not due to changes in the electronic band structure on alloying. The lattice thermal conductivity of copper-gold alloys at liquid oxygen temperatures is limited by the scattering of phonons at the gold atoms, which are much heavier than the copper atoms. The magnitude of the thermal resistance is consistent with the theory of isotope scattering in dielectric solids. A.

536.212.2

4911. LATTICE CONDUCTIVITY OF TIN. M.Garfinkel and P.Lindenfeld.
Phys. Rev., Vol. 110, No. 4, 883-7 (May 15, 1958).

The thermal conductivities of several impure tin specimens were measured at liquid helium temperatures. Impurities of antimony, bismuth, and indium between 0.1% and 6% were used to lower the electronic conductivity. The conductivities are found to be consistent with the equation $K = \alpha T + \beta T^3$, where the first term may be ascribed to the electronic conductivity and the second to the lattice conductivity. For impurities of 3% or less the values of α, combined with measurements of the residual electrical resistivity, agree to about 1% with the prediction of the Wiedemann—Franz law. For the same samples β is approximately constant with a mean value of $(3.5 \pm 0.4) \times 10^{-4}$ watt/cm deg^3. The comparative constancy of this value of β indicates that it is characteristic of the intrinsic conductivity of the tin lattice. A.

536.212.3

4912. HEAT CONDUCTION IN BISMUTH TELLURIDE. H.J.Goldsmid.
Proc. Phys. Soc., Vol. 72, Pt 1, 17-26 (July, 1958).

The Lorenz number of the semiconductor Bi_2Te_3 was evaluated, for the range of partial degeneracy, from data provided by the measurements of electrical conductivity and thermoelectric power. The calculated electronic component of the thermal conductivity, for n-type material, was found to agree with the experimental results, assuming the lattice thermal conductivity to be independent of the electrical conductivity. Agreement was also obtained for non-halogen-doped n-type Bi_2Te_3, but not for halogen-doped material. It was shown that the reason for this is the high effective scattering cross-section, for phonons, of the halogen atoms. The theory of the transport of ionization energy was found to agree very closely with experiment. A.

536.212.3

4913. DEVIATIONS FROM ONE-DIMENSIONAL HEAT FLOW IN GUARDED HOT-PLATE MEASUREMENTS. W.Woodside.
Rev. sci. Instrum., Vol. 28, No. 12, 1033-7 (Dec., 1957).

A theoretical analysis is made of the error in thermal conductivity, measured by the guarded hot-plate apparatus, resulting from a temperature difference, or unbalance, between the test area and the guard-ring. The solution is obtained by the application of two successive Schwartz transformations, the assumptions having been verified by relaxation calculations. An expression is derived for the error heat-flow in the test specimens. The agreement between calculated and measured values of the error heat flow for three different hot plates, for which experimental data are available, is 5% or better. It is therefore now possible to calculate the maximum tolerable unbalance to achieve any desired accuracy in thermal conductivity measured by the guarded hot plate. A.

536.23

4914. THE THERMAL CONDUCTIVITY OF ASSOCIATING GASES. E.Whalley.
Disc. Faraday Soc., No. 22, 54-63 (1956).

A gas that associates to dimers and trimers has critical properties. The thermal conductivity of such a gas was calculated assuming that the diameter of the molecules is small compared with the mean free path and that inelastic collisions have negligible direct effect on the transport properties. The equation for the transport of energy contains four terms, relating to the transport of kinetic and internal energy by both internal circulation and conduction. The calculations were compared with the thermal conductivity of real gases to try to obtain some insight into the mechanism of transport in dense gases. A.

536.23 : 533.7

SOLUTION OF BOLTZMANN—HILBERT INTEGRAL EQUATION. COEFFICIENT OF HEAT CONDUCTION. See Abstr. 4793

536.24

4915. ON THE RATE OF HEAT TRANSFER IN LIQUIDS WITH GAS INJECTION THROUGH THE BOUNDARY LAYER. E.E.Gose, E.E.Peterson and A.Acrivos.
J. appl. Phys., Vol. 28, No. 12, 1509 (Dec., 1957).

Summarizes the results of a preliminary experimental investigation of whether the liquid heat transfer coefficient h increases when a small amount of gas (nitrogen) is injected through a porous surface (sintered-bronze of about 25% porosity) to the flowing liquid (water) stream. Curves of h as a function of the volumetric rate of nitrogen injection, at various Reynolds numbers, are shown. S.Weintroub

536.33

4916. THERMAL RADIATION FROM AN ANISOTROPIC MEDIUM. F.V.Bunkin.
Zh. éksper. teor. Fiz., Vol. 32, No. 4, 811-21 (1957). In Russian.
English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 4, 665-73 (Nov., 1957).

The radiation emitted by an element of volume of an anisotropic medium is examined on the basis of the electrodynamic theory of thermal radiation. A generalization of Kirchhoff's law is given. The thermal radiation from continuously varying magnetoactive media is considered. The case of weak gyrotropy is considered in some detail. A.

536.33 : 535.33.07

INFLUENCE OF THERMAL RADIATION ON SPECTROSCOPIC PROCESSES. See Abstr. 4855

536.33.08 : 535.23.08

4917. A COMPARISON OF FAST INFRARED DETECTORS. M.N.Markov.
Optika i Spektrosk., Vol. 3, No. 2, 158-61 (1957). In Russian.

The problem of defining the most significant characteristics of these detectors is discussed. A table is included, based on the criteria of Jones (Abstr. 4595/1949), with the time-constant, area, d.c. sensitivity and minimum detectable radiation figures of U.S.A., British and Russian detectors (bolometers, thermopiles, Golay cells and photoconductive devices). L.Bovey

536.37

4918. RADIATION FRONTS. A.R.Fraser.
Proc. Roy. Soc. A, Vol. 245, No. 1243, 536-45 (1958).

When intense thermal radiation penetrates into a cold fluid the front separating hot and cold fluid may be well defined. When this is so, conservation laws, similar to those which are used across a shock

front, can be applied to the radiation front. These conservation laws, together with the second law of thermodynamics, are used to classify the types of front which can exist. Analogies are drawn between radiation fronts and detonation waves or deflagration waves. A.

536.421 : 537.22

4919. THE GENERATION OF E.M.F. DURING MELTING AND FREEZING OF IONIC CRYSTALLINE SUBSTANCES.
K.Azuma and H.Kametani.
J. Phys. Soc. Japan, Vol. 12, No. 3, 313-14 (March, 1957).

The substance is placed in a silica tube, which after preheating is slowly passed through a furnace, so that a melting zone travels along the substance followed by a freezing zone. For several alkali halides, e.m.f.'s were observed when either phase boundary was moving between the two electrodes mounted within the tube. When the boundary was held stationary no e.m.f. occurred. The e.m.f.'s quoted are all about 0.3 V and thus similar to that calculated for a NaCl crystal in contact with its vapour (Abstr. 7298/1953). Similar phenomena have been observed by the authors for silicates (Journal of the Mining Institute of Japan, Vol. 72, 577, 1956).
R.C.Kell

536.421 : 539.2

RELATIONSHIP BETWEEN MELTING POINT AND LATTICE ENERGY IN SOME MOLECULAR SOLIDS. See Abstr. 4406

536.421.1

4920. ON THE MELTING OF IONIC CRYSTALS. T.Kurosawa.
J. Phys. Soc. Japan, Vol. 12, No. 4, 338-46 (April, 1957).

Comparing the data on AgCl and NaCl crystals, it is suggested that the contribution of lattice defects is more important than that of lattice vibrations. The Coulombic interaction between defects can cause a sort of phase transition, and the transition temperature is near the melting point. Experimental evidence: melting point, latent heat, viscosity and ionic conductivity of liquids, is discussed on this ground. A.

536.423 : 551.508.72

INSTRUMENT FOR MEASURING EVAPORATION FROM NATURAL SURFACES. See Abstr. 4552

536.46 : 535.333

4921. ON THE "ATOMIC FLAME" OF HEAVY HYDRAZOIC ACID AND ATOMIC HYDROGEN.
G.Pannetier, H.Guénebaut and A.G.Gaydon.
C.R. Acad. Sci. (Paris), Vol. 246, No. 1, 88-90 (Jan. 6, 1958).
In French.

The identification of the Q head of the (3,2) band of the $^3\Pi$-$^3\Sigma$ system of ND enables the dissociation limit of the excited $^3\Pi$ state to be extrapolated to N(^{2}D). The previous hypothesis for the mechanism of formation of NH is confirmed. In the flame of N_2O with atomic hydrogen, very different values of the ratio I_{ND}/I_{NH} are found for the singlet and triplet systems. A.G.Gaydon

536.46 : 535.333

4922. THE LUMINOUS MANTLE OF FUEL-RICH OXYACETYLENE FLAMES. I. SPECTROSCOPIC TEMPERATURE MEASUREMENTS. G.V.Marr.
Canad. J. Phys., Vol. 35, No. 11, 1265-74 (Nov., 1957).

The luminous mantle of fuel-rich oxyacetylene flames is a strong source of the 4050 A bands of the C_3 radical. As a preliminary to the study of the chemical kinetics involved in the formation of the electronically excited C_3 radical, a temperature investigation of the luminous mantle was undertaken. Rotational measurements are reported for the CH, C_2, and OH bands over a range of burning mixtures of 2.3 to 4.2 times stoichiometric. Self-absorption is shown to occur for OH and C_2 and is indicated for CH. After attempting to correct for this effect, an average rotational temperature for the three radicals of 3000 ± 200° K decreasing to 2900 ± ± 200° K is found to be applicable to the luminous mantle over the range of mixtures investigated. Vibrational temperatures obtained for CN and C_2, together with predissociation studies ot the CH radical, indicate that small departures from complete thermal equilibrium cannot be eliminated. A.

536.46 : 535.333

4923. THE LUMINOUS MANTLE OF FUEL-RICH OXYACETYLENE FLAMES. II. FREE RADICAL AND CONTINUUM INTENSITIES, AND THEIR INFLUENCE ON C_3 EMISSIONS. G.V.Marr.
Canad. J. Phys., Vol. 35, No. 11, 1275-83 (Nov., 1957).

The spectroscopic emissions from the luminous mantle of the oxyacetylene flame was examined over a range of burning mixtures from 2.3 to 4.2 times stoichiometric. Plots of the band-head intensities for the radicals C_2, C_3, CH, and CN for different burning mixtures and for vertical traverses through the flame are reported. From a study of the variation of the background continuum from 3000 A to 5200 A with burning mixtures, the over-all continuum may be considered to consist of (a) a black-body carbon particle continuum having an energy distribution corresponding to a temperature of 2900 ± 200° K, (b) a continuum associated with the C_3 radical emissions extending from 3500 A to 4600 A with a maximum at 4000 A, and (c) an ultraviolet continuum extending from below 3000 A to 5000 A which appears similar to the carbon-monoxide flame continuum. Within the limits of experimental error the variation of the C_2 bands and their associated continuum are identical. Possib reaction mechanisms for the production of the C_3 emissions are considered and they probably may be accounted for by the reaction scheme $C_2(X\,^3\Pi) + C(^3P) \rightarrow C_3(\Sigma) + h\nu$ (cont.) followed by $C_3(\Sigma) \rightarrow C_3(\Pi) + h\nu$ (bands). A.

536.461 : 537.583

ELECTRON CONCENTRATIONS IN CARBON FLAMES. See Abstr. 4094

536.48

4924. DETECTION OF SINGLE QUANTA OF CIRCULATION IN ROTATING HELIUM II. W.F.Vinen.
Nature (London), Vol. 181, 1524-5 (May 31, 1958).

Describes an experiment in which the strength of fluid circulation around a fine wire is measured by the consequent splitting in frequency of the two transverse modes of vibration of the wire. Under the appropriate conditions, the measured circulation agreed within the experimental accuracy (2-3%) with the value h/m predicted by the Onsager–Feynman theory. For a free vortex line, the core radius appears to be much larger than previously believed.
R.G.Chambers

536.48

4925. MOBILITIES OF He IONS IN LIQUID HELIUM.
L.Meyer and F.Reif.
Phys. Rev., Vol. 110, No. 1, 279-80 (April 1, 1958).

These were measured by the method of Tyndall and Powell (Abstr. 613/1931) at 4.2°K, and between the λ-point and 1.18°K. In the latter range the mobility is roughly inversely proportional to the density of the normal fluid. The ratio of the mobilities of the negative and positive ions varies from 0.77 at 2°K to 0.62 at 1.18°K.
H.London

536.48 : 536.632

4926. SPECIFIC HEAT OF He^3 BELOW 1° K.
D.F.Brewer, A.K.Sreedhar, H.C.Kramers and J.G.Daunt.
Phys. Rev., Vol. 110, No. 1, 282-4 (April 1, 1958).

Extension of the measurements down to 0.085° K now allows unambiguous linear extrapolation to 0° K with a slope of 3.75 cal mol^{-1} deg^{-2}. The entropy at 0.5° K calculated from the specific heat is 1.39 ± 0.03 cal mol^{-1} deg^{-1}, compared with 1.44 cal mol^{-1} deg^{-1} calculated from vapour pressure data. It follows from the linear Fermi-type specific heat that in He^3 an abundance of low single-particle excitations exists down to 0° K, thus preventing the occurrence of superfluidity, a conclusion inherent in the original statistical approach of F.London.
H.London

536.48

4927. AN EXPERIMENTAL AND THEORETICAL STUDY OF TORSIONAL OSCILLATIONS IN UNIFORMLY ROTATING LIQUID HELIUM II. H.E.Hall.
Proc. Roy. Soc. A, Vol. 245, No. 1243, 546-61 (1958).

Measurements were made of the period $(2\pi/\Omega)$ of small torsional oscillations of an Andronikashvili disk system, superposed on a uniform rotation with angular velocity ω_0. If the changes in period are expressed formally as an effective density of liquid ρ' that moves with the disks, it is found that, for sufficiently rough disk surfaces and sufficiently small amplitudes of oscillation (i) for $\omega_0 \gg \Omega$, ρ'/ρ_s increases monotonically from 0 to 1 with increasing ω_0 and increasing disk separation; (ii) for $\omega_0 \ll \Omega$, ρ' can be either positive or negative; when plotted as a function of disk separation it shows a resonance-dispersion type of behaviour. These results can be explained by the vortex line model of Onsager and Feynman in terms of a transverse wave motion of the vortex lines, if it is supposed that the ends of the lines tend to stick to a sufficiently rough surface. The theory of these vortex waves was worked out in some detail. The behaviour of the liquid is determined by a parameter $\nu = \epsilon/\rho_s\kappa$, where ϵ is the energy of unit length of vortex line and κ is the circulation round a line; comparison of theory and experiment gives $\nu = (8.5 \pm 1.5) \times$

$\times 10^{-4}$ cm^2 sec^{-1}, some 25% less than Feynman's theoretical estimate. In the final section some consequences of the existence of vortex waves are discussed. A.

536.48

4928. THE THERMODYNAMICS OF LIQUID He^3.
I.M.Khalatnikov and A.A.Abrikosov.
Zh. éksper. teor. Fiz., Vol. 32, No. 4, 915-19 (1957). In Russian.
English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 4, 745-8 (Nov., 1957).

The thermodynamics of liquid He^3 is considered on the basis of the Fermi liquid model proposed by Landau (Abstr. 8604/1956). The entropy, the specific heat, and the magnetic susceptibility of liquid He^3 are computed for the possible types of the energy spectrum of the liquid. Comparison with experiment is carried out. A.

536.48

4929. THE INFLUENCE OF AN ADMIXTURE OF He^3 ON THE VISCOSITY OF HELIUM II. V.N.Zharkov.
Zh. éksper. teor. Fiz., Vol. 33, No. 4(10), 929-32 (1957). In Russian.

Using the Landau theory of liquid helium as a basis, the coefficient of viscosity of a weak solution of He^3 in helium II was determined as a function of temperature and concentration. A.

536.48

4930. THERMODYNAMICS OF THE PHASE TRANSITION He I—He II IN SOLUTIONS OF HELIUM ISOTOPES.
B.N.Esel'son, M.I.Kaganov, and I.M.Lifshits.
Zh. éksper. teor. Fiz., Vol. 33, No. 4(10), 936-44 (1957). In Russian.

A thermodynamic consideration is given of the phenomena associated with a phase transition of the second kind in liquid solutions. The results obtained are compared with the experimental data concerning the equilibrium of the He^3—He^4 liquid—vapour system. A.

536.48 : 533.12 : 532.14

OPTICAL DETERMINATION OF THE DENSITY OF He^3.
See Abstr. 4779

536.48 : 532.5

4931. HYDRODYNAMICS OF SOLUTIONS OF TWO SUPERFLUID LIQUIDS. I.M.Khalatnikov.
Zh. éksper. teor. Fiz., Vol. 32, No. 4, 653-7 (1957). In Russian.
English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 4, 542-5 (Nov., 1957).

The hydrodynamical equations are obtained for solutions of two superfluid liquids on the basis of the conservation laws. In this case, three independent motions are possible in the liquid: a normal one with velocity v_n and two superfluid (potential) ones with velocities v_s' and v_s''. Three different types of sound vibrations can be propagated in such solutions. A.

536.48 : 539.14

SUPERFLUIDITY IN THE THEORY OF NUCLEAR MATTER.
See Abstr. 4256

536.52 : 534.222.2

4932. MEASUREMENT OF HIGH TEMPERATURES IN STRONG SHOCK WAVES IN GASES. I.Sh.Model'.
Zh. éksper. teor. Fiz., Vol. 32, No. 4, 714-26 (1957). In Russian.
English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 4, 589-601 (Nov., 1957).

A photographic method for the measurement of high temperatures and the absorption coefficient of radiation by the gases in a plane shock wave is described. Results of the measurement of the temperature and absorption coefficient of a plane shock wave in air are presented for wave velocities between 6.4 and 8 km/sec. In strong shock waves in heavy inert gases the experimentally measured temperatures are much lower than the calculated values. It is suggested that this phenomenon is due to screening of the shock wave front by a layer of gas heated by radiation from the shock front. A.

536.521 : 537.525.8

4933. TEMPERATURE DETERMINATION FROM THE VIBRATIONAL STRUCTURE OF N_2, CO AND CN BANDS IN A GLOW DISCHARGE. V.N.Elizar'eva.
Optika i Spektrosk., Vol. 3, No. 1, 61-7 (1957). In Russian.

The (0-3) 4059.4 A N_2, (0-2) 5198 A CO and the (0-1) 4216 A CN bands were photographed on a three-prism instrument for various percentage mixtures of the gases at pressures between 0.5 and 6 mm Hg. Tables of the derived vibrational temperatures are given. 10% H_2 was present so that the electron temperature could be assumed from previous work on the relative intensity of hydrogen lines. It is concluded that in N_2 and CO the vibrational and electronic temperatures are equal, whereas in CN they differ. The effect of pressure on temperature is also discussed. L.Bovey

536.531

4934. A SIMPLE FORMULA FOR USE WITH CARBON THERMOMETERS AT LOW TEMPERATURES. O.V.Lounasmaa.
Phil. Mag. (Eighth Ser.), Vol. 3, No. 30, 652-3 (June, 1958).

For a 47 Ω resistor, the formula $T + \Theta = A/(R - R_0)$ fits well between 4°K and 12°K, where Θ, A and R_0 are constants; R_0 varies slightly from run to run. R.G.Chambers

536.631

4935. HEAT CAPACITY OF COPPER—GERMANIUM ALLOYS BELOW 4.2°K. J.A.Rayne.
Phys. Rev., Vol. 110, No. 3, 606-11 (May 1, 1958).

Heat capacity measurements below 4.2°K were made on a series of alloys in the primary phase of the copper—germanium system. When corrected for lattice expansion, the resulting change in the electronic specific heat for low electron/atom ratios is found to be the same as that for the copper—zinc system. In neither case is the variation consistent with that expected for a parabolic valence band, thereby lending support to the previously advanced hypothesis that the Fermi surface in copper departs appreciably from sphericity. Both systems exhibit the same variation of Debye temperature with electron concentration, when appropriate corrections are made for the differences in the atomic mass and volume of the two alloy series. This supports the idea that the variation of the elastic constants in these alloys is influenced principally by the proximity of the Fermi surface to the boundaries of the first Brillouin zone. The variation of elastic constants with solute concentration, as deduced from the present work, is compared with that obtained from ultrasonic pulse measurements at room temperature. A.

536.631

4936. HEAT CAPACITY OF LAMINAR LATTICES AT LOW TEMPERATURES. E.S.Itskevich and P.G.Strelkov.
Zh. éksper. teor. Fiz., Vol. 32, No. 3, 467-77 (1957). In Russian.
English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 3, 394-402 (Oct., 1957).

The heat capacity of three anhydrous cadmium salts — CdI, $CdBr_2$, and $CdCl_2$ — which are classical laminar crystals was measured in the temperature interval from 1.6 to 100°K. Possible thermal effects of sorption were excluded by carrying out the measurements on pressed preparations without heat exchanging gas. At helium temperatures, the heat capacities of all three salts obey a cubic law. In the 4-10°K range, the exponent in this relationship exceeded three for all three salts. Above 10°K, the exponent starts to decrease continuously and in a certain region the relation becomes quadratic; the region in which this relation holds decreases from the iodide to the chloride. Still higher, the relation is linear, the region of which increases from the iodide to the chloride. Attempts are made to compare the experimental results with theory. A.

THERMODYNAMICS

536.7 : 537.226

4937. CONSTRUCTION OF THE THERMODYNAMIC POTENTIAL OF ROCHELLE SALT FROM THE RESULTS OF THE OPTICAL INVESTIGATION OF [FERROELECTRIC] DOMAINS.
V.L.Indenbom and M.A.Chernÿsheva.
Zh. éksper. teor. Fiz., Vol. 32, No. 4, 697-701 (1957). In Russian.
English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 3, 575-9 (Nov., 1957).

From the experimental temperature dependence of the monoclinic parameter η and the specific heat c, the thermodynamic potential of Rochelle salt can be constructed with accuracy to terms of the order of η^4. The advantages of the optical method of determination of the monoclinic parameter was analysed in comparison with the electrical and mechanical methods. Results of calculation of the thermodynamic potential surface from the temperature dependence of the angle of spontaneous rotation of the optical indicatrix are given. The possibilities of rigorous construction (without interpolation) of this surface from data of the optical investigation of ferroelectric domains are pointed out. A.

ELECTRICITY

ELECTROSTATICS. DIELECTRICS

537.222.1

4938. THE CHARGE DENSITY NEAR A SHARP POINT ON A CONDUCTOR. R.Cade.
Proc. Cambridge Phil. Soc., Vol. 53, Pt 4, 870-7 (Sept., 1957).

A brief discussion is given of attempts that have been made to justify, in terms of electrostatic principles, the conjecture that surface charge on a conductor tends to infinity towards a convex sharp point and to zero towards a concave point, and it is concluded that the problem has not hitherto been solved. A new attempt is then made using potential-theoretic methods, and the problem is solved with a fair degree of generality. The limitations are of a kind familiar in this type of analysis and, roughly speaking, concern the degree of convexity of the conducting surface. A.

537.226

4939. THE MAGNITUDE OF THE FORCE IN A DIELECTRIC. E.Durand.
C.R. Acad. Sci. (Paris), Vol. 245, No. 12, 1003-6 (Sept. 16, 1957). In French.

An expression is given for the force when the dielectric is placed in an electric field. This is a volume integral and it is converted into a surface integral in several ways. The force is related to polarization and induction. L.S.Goddard

537.226.1

4940. EFFECTIVE FIELD IN CRYSTALS. Yu.V.Bogomolov.
Zh. tekh. Fiz., Vol. 28, No. 2, 250-1 (1958). In Russian.

Reference is made to Skanavi's equation (Zh. éksper. teor. Fiz., Vol. 17, No. 5, 399, 1947) for calculating the static permittivity of a crystal consisting of spherical neutral polarizable atoms, and a more general set of equations is developed for the case when the direction of the effective field does not coincide with that of the external field. F.Lachman

537.226.1 : 538.222 : 539.19

4941. ELECTROMAGNETIC PROPERTIES OF COMPRESSED GASES. A.D.Buckingham and J.A.Pople.
Disc. Faraday Soc., No. 22, 17-21 (1956).

The effects of molecular interactions on several equilibrium electromagnetic properties of compressed gases are discussed. A suitably-chosen measurable property is expanded in inverse powers of the molar volume, and the term representing initial deviations from perfect-gas behaviour, and therefore depending upon pair interactions only, is examined in detail. The particular properties dealt with include the dielectric constant, refractive index, Kerr and Cotton-Mouton constants and the molar paramagnetic susceptibility. The usefuleness of each property in yielding information about intermolecular forces is discussed; the dielectric constant and the Kerr and Cotton-Mouton constants are particularly suitable as aids to the study of orientationally-dependent forces, while it is suggested that observations of the density dependence of the magnetic susceptibility of oxygen might throw some light on the relative magnitudes of the interaction energies of the singlet, triplet and quintuplet dimers. A.

537.226.2 : 537.228.1 : 621.315.612.4

4942. PIEZOELECTRIC AND DIELECTRIC CHARACTERISTICS OF SINGLE-CRYSTAL BARIUM TITANATE PLATES. A.H.Meitzler and H.L.Stadler.
Bell Syst. tech. J., Vol. 37, No. 3, 719-38 (May, 1958).

The dielectric constant of c-domain barium titanate single-crystal plates was measured as a function of their average polarization, using a.c. voltages much smaller than the coercive voltage. As has been found previously, the dielectric constant at frequencies below thickness fundamental resonance has a minimum at zero average polarization. However, at frequencies well above thickness resonance the dielectric constant has a maximum at zero polarization. The variation is about 25% from minimum to maximum in both frequency ranges. In both frequency ranges the conductance is highest at zero polarization. The piezoelectric output voltage of a $BaTiO_3$ single crystal subjected to a recurrent strain pulse of constant amplitude was found to be approximately, but not exactly, proportional to its average polarization. There appears, in fact, to be a distinct hysteresis in the dependence. A.

537.226.2 : 548.4

WEDGE-SHAPED DOMAINS IN $BaTiO_3$ CRYSTAL. See Abstr. 4518

537.226.2

4943. POLARIZATION IN THORIUM OXIDE CRYSTALS. W.E.Danforth and J.H.Bodine.
J. Franklin Inst., Vol. 260, No. 6, 467-83 (Dec., 1955).

Studies were made of the electrical polarization resulting from the passage of current in single crystals of low-oxygen thorium oxide at elevated temperatures. The e.m.f. across the crystal necessary to maintain a constant current rises by a factor of 100 and more during the establishment of the final equilibrium. The resistivity of the material was found to vary from 6000 ohm cm at 900° C, to 400 ohm cm at 1300° C, and to be unchanged by large values of polarization. Indications point to a critical potential for the onset of electrolysis in the neighbourhood of 0.3 V. The dependence of initial conductance upon temperature point to an activation energy for the initial conductance of 1.1 eV, and the same temperature dependence is approximately valid over the whole polarization curve. Theoretical considerations indicate that ions and electrons are both mobile and, to account for the high polarization ratios, it appears that the fraction of current carried by the electrons is less than 1% of the total. A.

537.226.2 : 535.417 : 539.232

DETERMINATION OF DIELECTRIC CONSTANT OF ANODIC OXIDE FILMS ON TANTALUM. See Abstr. 4464

537.226.33 : 537.311.32

DIELECTRIC RELAXATION AND THE ELECTRICAL CONDUCTIVITY OF ICE CRYSTALS. See Abstr. 3990

537.228.1 : 611.71

4944. ON THE PIEZOELECTRIC EFFECT OF BONE. E.Fukada and I.Yasuda.
J. Phys. Soc. Japan, Vol. 12, No. 10, 1158-62 (Oct., 1957).

The specimens were cut from the femurs of a man and an ox, and dried completely by heating. The piezoelectric constants were measured by three different methods: the static direct effect; the dynamic direct effect; and the dynamic converse effect. The piezoelectric effect appears only when the shearing force is applied to the collagen fibres to make them slip past one another. The magnitude of the piezoelectric constant depends on the angle between the applied pressure and the axis of the bone. Its maximum value is 6×10^{-9} c.g.s. e.s.u., which is about one-tenth of the piezoelectric constant d_{11} of quartz. The specimens, which were boiled in water and afterwards dried completely, showed little change in the piezoelectric effect, indicating that the effect is not of biological origin, but may be ascribed to the piezoelectricity of the crystalline micelle of collagen molecules. Consideration of the symmetry of the configuration of collagen fibres in the bone texture shows the existence of effects that are represented by only two piezoelectric constants d_{14} and d_{25}, which are the same in magnitude but opposite in sign. A.

ELECTRIC CONDUCTION. CURRENTS

537.3.081.3 : 621.317.311

4945. MEASUREMENT OF CURRENT WITH A PELLAT-TYPE ELECTRODYNAMOMETER. R.L.Driscoll.
J. Res. Nat. Bur. Stand., Vol. 60, No. 4, 287-96 (April, 1958).

The value of an electric current was determined in absolute measure by means of an electrodynamometer, and simultaneously by standard cells and standard resistors as currently maintained. The electrodynamometer used was of the Pellat type, and featured a fused-silica balance beam and single-layer helical coils. The relation of the N.B.S. ampere to the absolute ampere, from this determination, may be expressed as

1 N.B.S. ampere = 1.000013 absolute amperes.

The uncertainty in this result from all known sources is estimated to be eight parts per million. A.

537.3.081.3 : 621.317.311

4946. MEASUREMENT OF CURRENT WITH THE NATIONAL BUREAU OF STANDARDS CURRENT BALANCE. R.L.Driscoll and R.D.Cutkosky.
J. Res. Nat. Bur. Stand., Vol. 60, No. 4, 297-305 (April, 1958).

Prior to the adjustment of the electrical units in 1948, the value of a current had been determined in absolute units by means of a current balance and simultaneously measured in N.B.S. amperes by

comparison with standard resistors and standard cells. This work was reported earlier (1942). Similar measurements made recently with an electrodynamometer indicate a possible change in the values of the standards. The present paper reports a repetition of the work using a current balance. The purpose of this re-measurement was to determine whether or not the standards had changed. Only minor changes were made in the equipment in order that factors which might have introduced small systematic errors in the results would remain unchanged. According to the work described in this paper, 1 N.B.S. ampere = 1.000008 absolute amperes. Recent work with the Pellat electrodynamometer (see the preceding abstract) gave the result 1 N.B.S. ampere = 1.000013 absolute amperes. The weighted mean of these two values is

1 N.B.S. ampere = 1.000010 ± 0.000005 absolute amperes

The results given above for the current balance differ by 6 p.p.m. from those obtained in 1942. This indicates, in view of the uncertainties of measurement, that any change in the ampere as maintained by standard resistors and standard cells does not exceed a few parts in a million. A.

537.311.1

4947. THE ELECTRIC CURRENT AND QUANTUM MECHANICS.
G.Pocholle.
Ann. Télécomm., Vol. 12, No. 9, 290-8 (Sept., 1957). In French.

It is shown that the application of Planck's quantum law to electric current in conductors leads to a simple explanation of superconductivity in metals at low temperatures, and it is suggested that the Joule effect results from the interaction between the electrical energy and the internal thermal energy of materials. Experimental results support these ideas. The generalization of these principles leads to the conclusion that entropy changes in discontinuous systems occur in quanta. The name "phonon" is proposed for the quantum of electrical energy propagating in conductors corresponding to the "photon", the quantum of electromagnetic energy propagating in space. R.C.Glass

537.311.1

4948. GENERALIZATION OF THE VARIATION PRINCIPLE IN THE THEORY OF ELECTRICAL CONDUCTIVITY.
V.Glaser and B.Jakšić.
Nuovo Cimento, Vol. 7, No. 2, 259-62 (Jan. 16, 1958).

A variational principle is derived for the solution of the two coupled integral equations which govern the electron and phonon distributions when the phonon distribution is not considered to be that of thermal equilibrium. S.F.Edwards

537.311.1 : 539.217

ABNORMAL VALUES OF 'A' AND 'E' IN MIGRATION PROCESSES. See Abstr. 4453

537.311.1 : 537.56 : 533.7

KINETIC AND POTENTIAL ENERGIES OF AN ELECTRON GAS. See Abstr. 4794

537.311.2

4949. ELECTRIC CONTACT TO ZINC SULPHIDE CRYSTALS.
G.F.Alfrey and I.Cooke.
Proc. Phys. Soc. B, Vol. 70, Pt 11, 1096-8 (Nov., 1957).

When small pieces of In are placed on a ZnS crystal and heated at 600° C for a short time, low-resistance ohmic contacts are obtained. Evaporated or pressed-foil contacts give non-ohmic behaviour and show electroluminescence, but after the application of high fields (~ 40 kV/cm) the current increases by several orders of magnitude, and the specimen no longer shows electroluminescence. After breakdown I is proportional either to V or to V^8, as predicted generally by Lampert (Abstr. 352/1957). C.A.Hogarth

537.311.31 : 539.219

4950. THE THEORY OF THE RESIDUAL ELECTRICAL RESISTANCE OF MULTICOMPONENT ORDERING ALLOYS.
A.M.Dykhne, Z.A.Matysina and A.A.Smirnov.
Fiz. Metallov i Metallovedenie, Vol. 5, No. 2, 220-9 (1957). In Russian.

The residual electrical resistance of an arbitrary lattice is calculated, taking into account correlations between the probabilities that neighbouring lattice sites will be filled by atoms of various kinds. No account is taken of long-range order. A.F.Brown

537.311.31

4951. ELECTRICAL CONDUCTIVITY OF METALS AT LOW TEMPERATURES. I.Supek.
Z. Phys., Vol. 149, No. 3, 324-8 (1957). In German.

A treatment of the Bloch integral equation when the energy surfaces E(k) = constant are not necessarily spherical. A differential equation involving E(k) is obtained for the distribution function, and its solution in the case of spherical energy surfaces agrees with the Bloch result. D.M.Edwards

537.311.31 : 539.234

ELECTRICAL PROPERTIES OF EXTREMELY THIN SILVER FILMS. See Abstr. 4465

537.311.31 : 536.212.2

ELECTRICAL CONDUCTIVITIES OF SOME COPPER ALLOYS. See Abstr. 4910

537.311.33 : 535.343

4952. INTENSITY OF OPTICAL ABSORPTION BY EXCITONS.
R.J.Elliott.
Phys. Rev., Vol. 108, No. 6, 1384-9 (Dec. 15, 1957).

The intensity of optical absorption close to the edge in semiconductors is examined using band theory together with the effective-mass approximation for the excitons. Direct transitions which occur when the band extrema on either side of the forbidden gap are at the same $\vec{K}$, give a line spectrum and a continuous absorption of characteristically different form and intensity according as transitions between band states at the extrema are allowed or forbidden. If the extrema are at different $\vec{K}$ values, indirect transitions involving phonons occur, giving absorption proportional to $(\Delta E)^{1/2}$ for each exciton band, and to $(\Delta E)^2$ for the continuum. The experimental results on Cu_2O and Ge are in good qualitative agreement with direct forbidden and indirect transitions, respectively. A.

537.311.33 : 535.343

4953. DIRECT OPTICAL TRANSITIONS AND FURTHER EXCITON EFFECTS IN GERMANIUM.
G.G.Macfarlane, T.P.McLean, J.E.Quarrington and V.Roberts.
Proc. Phys. Soc., Vol. 71, Pt 5, 863-6 (May, 1958).

Absorption measurements in the region of 4000 cm^{-1} have shown a fine structure which confirms the existence of excitons in Ge. The measurements are interpreted in terms of a theory developed by Elliott (see the preceding abstract) and a plot of direct gap-width against temperature, as well as the exciton binding energy, are derived. K.W.Plessner

537.311.33

4954. THEORY OF AN EXPERIMENT FOR MEASURING THE MOBILITY AND DENSITY OF CARRIERS IN THE SPACE-CHARGE REGION OF A SEMICONDUCTOR SURFACE. R.L.Petritz.
Phys. Rev., Vol. 110, No. 6, 1254-62 (June 15, 1958).

The use of galvanomagnetic experiments to determine the mobility and density of carriers in the space-charge region of a semiconductor surface is considered. An approximate model is used: it is a single crystal composed of two regions, a surface region of thickness of the order of a Debye length and a bulk region. Expressions for the resultant Hall coefficient are given for three experimental configurations by use of circuit analysis. The sensitivity of each configuration is derived, and by also considering experimental desirability, one is selected for study. It has the magnetic field perpendicular to the surface and the Hall voltages of surface and bulk are in parallel. Changes in Hall voltages of 1 to 50% are expected by using ambients to change the surface potential. The model is assumed to be a single crystal with continuous variation of the potential in the direction perpendicular to the surface. Rigorous expressions are derived for the Hall coefficient and magnetoresistance by use of the one-dimensional Boltzmann equation. A feature of the derivation is its independence of a specific model of the surface region. The resulting expressions contain surface densities and mobilities which can be evaluated from experimental data of Hall coefficient and conductivity. Conversely, the expressions can be used with theory based on specific surface models to predict values of conductivity, Hall coefficient, and magnetoresistance. A.

537.311.33

4955. MAGNETO-SURFACE EXPERIMENTS ON GERMANIUM.
J.N.Zemel and R.L.Petritz.
Phys. Rev., Vol. 110, No. 6, 1263-71 (June 15, 1958).

A study was made of the ambient-induced changes in the conductivity, Hall coefficient, and magnetoresistance of thin samples of intrinsic germanium. The data are analysed by means of the

theory given in the preceding abstract. The results indicate that light holes play an important role in the transport process in the surface, especially in the dependence of the zero of the Hall coefficient with increasing surface hole density. It is also shown that there is a reduction of the mobility of surface electrons in qualitative agreement with the predictions of Schrieffer (Abstr. 2732/1955). The results, in general, agree with the current view of semiconductor surfaces. A.

537.311.33 : 621.315.59

4956. ELECTRONS, HOLES, AND TRAPS. W.Shockley.
Proc. Inst. Radio Engrs, Vol. 46, No. 6, 973-90 (June, 1958).

The statistics of recombination and of trapping of electrons and holes through traps of a single species are presented. The results of the Shockley–Read recombination theory are derived and more fully interpreted. A level of energy known as the equality level is introduced. When the Fermi level lies at this level, the four basic processes of electron capture, electron emission, hole capture, and hole emission all proceed at equal rates. Transient cases for large trap density are presented. A.

537.311.33 : 621.315.59

4957. RECOMBINATION IN SEMICONDUCTORS. G.Bemski.
Proc. Inst. Radio Engrs, Vol. 46, No. 6, 990-1004 (June, 1958).

Excess carriers in semiconductors recombine either by direct recombination of electrons and holes, or through the intermediacy of recombination centres. The latter process is the one observed in silicon and germanium. Various impurity atoms, dislocations, vacancies, and interstitials are known to act as recombination centres. The capture rates associated with these imperfections vary over a wide range depending on their state of charge. Recombination at the surface is described in terms of a similar model in which surface states replace the recombination centres present in the bulk. The surface recombination velocity measures the density and capture properties of these states. A given centre can act as a recombination centre or a trap depending on the relative magnitude of the capture cross-sections for electrons and holes. This paper reviews the analytical treatments of the different processes as well as specific experimental results. Bibliography of 131 items. A.

537.311.33 : 621.315.59

4958. ANALOG SOLUTION OF SPACE-CHARGE REGIONS IN SEMICONDUCTORS. L.J.Giacoletto.
Proc. Inst. Radio Engrs, Vol. 46, No. 6, 1083-5 (June, 1958).

Analytical solutions of space-charge regions in semiconductors can be carried out when a one-dimensional symmetry exists. Analogue solutions can be used to solve Poisson's equation for more complex geometries. An analogue method is described which has been used with some success. This method consists of a rubber membrane with surface mass loading being used to simulate the semiconductor space charge. A.

537.311.33 : 621.315.59

4959. NOISE IN SEMICONDUCTORS AND PHOTOCONDUCTORS. K.M.van Vliet.
Proc. Inst. Radio Engrs, Vol. 46, No. 6, 1004-18 (June, 1958).

A survey is given of theory and experiments on noise in bulk semiconductors and photoconductors. This paper is divided into four parts, including generation-recombination (gr) noise in semiconductors, gr noise in photoconductors, 1/f noise in single crystals, and modulation noise in granular materials. An account is given of the appropriate analyses and the results are applied to extrinsic as well as intrinsic fluctuations, generated either in the bulk or at the surface. The limiting sensitivity of photoconductors caused by photon noise is calculated and present infrared detectors are discussed. A survey is then given about present understanding of 1/f noise, and of its relation to the field effect as proposed by McWhorter and others. Finally, some remarks are made about 1/f noise in granular material and the proposed theories are briefly reviewed. A.

537.311.33 : 621.38

4960. ON THE NOISE GENERATED BY DIFFUSION MECHANISMS. K.M.van Vliet and A.van der Ziel.
Physica, Vol. 24, No. 6, 415-21 (1958).

Some diffusion theories for the generation of noise in semiconductors or tubes, published previously, are discussed (Abstr. 6490/1950). After removing some errors it is pointed out that these theories will never explain 1/f noise. However, the formalism is very useful for other diffusion phenomena. This is demonstrated for noise due to surface generation and recombination of carriers, for which a very general result is derived. A.

537.311.33

4961. SEMICONDUCTOR NOISE AS A QUEUING PROBLEM. D.A.Bell.
Proc. Phys. Soc., Vol. 72, Pt 1, 27-32 (July, 1958).

The outstanding problem of semiconductor noise is to account for a power spectrum of which the intensity appears to increase without limit as the frequency is decreased. There is no simple explanation in terms of relaxation times for a spectrum which is proportional to a constant power of frequency over many decades and which is found in a wide range of different materials. But it can be explained if the rate at which carriers leave the conduction band is treated as a queuing problem rather than a relaxation problem. The phenomenon in question is related to the presence of current, which implies that the carriers are swept away from the neighbourhood of the centres from which they originated, and the time to recombination is governed by the time taken to find a vacant centre elsewhere, not by the probability of falling back to the originating centre. A.

537.311.33

4962. ON A POSSIBLE MECHANISM FOR THE INCREASE IN THE CONDUCTIVITY OF ATOMIC SEMICONDUCTORS IN A STRONG ELECTRIC FIELD. F.G.Bass.
Zh. éksper teor. Fiz., Vol. 32, No. 4, 863-5 (1957). In Russian.
English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 4, 705-6 (Nov., 1957).

The effect of a decrease of the electron recombination rate in a strong electric field on the conductivity of atomic semiconductors is investigated. A.

537.311.33

4963. THE ELECTRICAL CONDUCTIVITY OF FERROMAGNETIC SEMICONDUCTORS (FERRITES). A.A.Yudin.
Zh. éksper. teor. Fiz., Vol. 33, No. 4(10), 873-6 (1957). In Russian.

Ferrite is regarded as a lattice of classical magnetic dipoles immersed in a dielectric continuum. A consideration of the electronic conductivity of such a model shows that the straight line $\ln\lambda \sim T^{-1}$ (λ is the electrical conductivity) should have a break at the Curie point with reduction of the activation energy in the ferromagnetic region, in agreement with experiment. A.

537.311.33 : 537.312.7

4964. ON THE BEHAVIOUR OF NONMETALLIC CRYSTALS IN STRONG ELECTRIC FIELDS. L.V.Keldȳsh.
Zh. éksper. teor. Fiz., Vol. 33, No. 4(10), 994-1003 (1957). In Russian.

An expression was obtained for the number of electron–hole pairs generated in a semiconductor by a uniform electric field. An arbitrary crystal was considered. The result differs from the usual formula by the presence of an explicit angular dependence and a slightly different dependence on the field. In the absence of collisions of electrons with phonons and of electrons among themselves the magnitude of the effective potential barrier is determined not by the width of the forbidden band, but by the lower edge of optical absorption (the internal photoeffect), which, as a rule, is considerably greater. This circumstance should lead to a considerable increase in the critical field. A.

537.311.33

4965. SEMICONDUCTOR LIFETIME AS A FUNCTION OF RECOMBINATION STATE DENSITY. D.H.Clarke.
J. Electronics and Control, Vol. 3, No. 4, 375-86 (Oct., 1957).

The analysis of the Shockley–Read model is extended to describe the transient behaviour. The results are compared with those already given by Fan and by Rittner, and it is concluded that the latter cease to be valid at high recombination state densities. The relation between steady state and transient measurements of photoconductivity is examined, and some numerical examples are presented. A.

537.311.33 : 534.26

4966. COOLING OF HOT ELECTRONS BY ACOUSTIC SCATTERING IN DEGENERATE SEMICONDUCTORS. R.F.Greene.
J. Electronics and Control, Vol. 3, No. 4, 387-90 (Oct., 1957).

Shockley's calculation of the energy loss rate of hot electrons by acoustic scattering in semiconductors is extended to include the case of degenerate electron statistics. A simple formula is given for the loss rate in terms of the acoustic mean free time, valid for any degree of degeneracy. A relaxation time for the electron energy is expressed in terms of the acoustic mean free time, showing the effect of degeneracy. A.

537.311.33 : 539.2

TRANSPORT PROCESSES IN SEMICONDUCTORS. See Abstr. 4420

537.311.33 : 539.2

IMPURITY CENTRES AND ACOUSTIC VIBRATIONS IN AN ATOMIC SEMICONDUCTOR. See Abstr. 4423

537.311.33

4967. PHYSICO-CHEMICAL ANALYSIS OF SOME SEMICONDUCTING SYSTEMS. N.Kh.Abrikosov.
Izv. Akad. Nauk SSSR, Ser. fiz., Vol. 2, No. 1, 141-5 (1957). In Russian.

A brief survey of work at the A.A.Baĭkov Institute of Metallurgy on the systems Cr—Sb, Co—Sb, Fe—Si, and Bi—Te. With all alloys studied particular care was taken to ensure that phase equilibrium was closely approached. Semiconducting behaviour was observed in: $CrSb_2$ (see Abstr. 416/1957), $CoSb_2$ and $CoSb_3$ (see Dudkin and Abrikosov, Zhurnal Neorganicheskoi Khimii, Vol. 1, 2096, 1956) and $FeSi_2$ (see Abrikosov, Izvestiya Sektora Fiziko-Khimicheskogo Analiza Akad. Nauk SSSR, Vol. 27, 157, 1956). In the Bi—Te system two new phases were found, one with a composition near Bi_2Te, the other with a range of composition of ~6% near 45 wt.% Te. Both apparently are formed peritectically. Brief mention of electrical properties included thermal activation energies of 0.2 eV for $CoSb_2$ and 0.5 eV for $CoSb_3$. C.H.L.Goodman

537.311.33

4968. THE CHEMICAL BOND IN SEMICONDUCTING COBALT TRIANTIMONIDE. L.D.Dudkin.
Zh. tekh. Fiz., Vol. 28, No. 2, 240-4 (1958). In Russian.

An attempt to explain semiconduction in $CoSb_3$ (see the preceding abstract) in terms of covalent (-ionic) bonding. In the $CoSb_3$ lattice Co is octahedrally coordinated (by Sb) and Sb is tetrahedrally coordinated (by 2 Sb and 2 Co). This coordination is interpreted in terms of two possible sets of bonding orbitals: d^2sp^3 for Co and sp^3 for Sb, or d^2s for Co and p^3 for Sb. The second is believed to be the more satisfactory. Both should lead to the filled valence shells apparently necessary for semiconducting behaviour (see Abstr. 9181/1956). C.H.L.Goodman

537.311.33

4969. NEW SEMICONDUCTING COMPOUNDS.
V.P.Zhuze, V.M.Sergeeva and E.L.Shtrum.
Zh. tekh. Fiz., Vol. 28, No. 2, 233-6 (1958). In Russian.

Electrical conductivity, thermoelectric power, Hall effect, crystal structure, melting point and microhardness were studied for $A^IFeX_2^{VI}$ compounds (A^I = Cu,Ag, X^{VI} = S,Se,Te), in particular $AgFeSe_2$ and $AgFeTe_2$. The latter had tetragonal structures, which were not of chalcopyrite type (though probably related to it). An electronic mobility greater than 2000 $cm^2V^{-1}sec^{-1}$ was obtained with polycrystalline $AgFeTe_2$ (~ 500 $ohm^{-1}cm^{-1}$). Evidence suggesting a phase transformation in this compound at ~145°C included a marked change in volume. Melting points (°C) and thermal activation energies (eV) were: $CuFeS_2$: 875, 0.53; $CuFeSe_2$: 574, 0.16; $CuFeTe_2$: 740, 0.10; $AgFeSe_2$: 757, 0.23; $AgFeTe_2$ 380, 0.28 (0.58 above 145° C). See also Abstr. 9180/1957.
C.H.L.Goodman

537.311.33

4970. THE IONIZATION ENERGY OF BISMUTH AND THALLIUM IN GERMANIUM. I.A.Kurova and S.G.Kalashnikov.
Zh. tekh. Fiz., Vol. 28, No. 2, 256-8 (1958). In Russian.

The energies were determined from measurements of the temperature variation of the resistivity (4-20° K). The germanium specimens contained 7×10^{14} to 6×10^{15} atoms of Bi or Tl per cm^3. The values deduced were 0.12 and 0.11 eV for Bi and Tl respectively. Additional measurements on Zn- and Sb-doped specimens confirmed the reliability of the method; the ionization energies obtained for Zn and Sb were 0.03 and 0.10 eV respectively, which agree with other reported values. The results obtained for Bi and Tl show that local deformations of the germanium lattice caused by introduction of atoms (Bi, Tl) with a radius different from that of Ge do not appreciably affect the ionization energy or the local energy levels of the impurity atoms. K.F.Hulme

537.311.33 : 538.632

4971. HEAT TREATMENT OF POLYCRYSTALLINE CADMIUM OXIDE. J.A.Bastin and R.W.Wright.
Proc. Phys. Soc., Vol. 72, Pt 1, 65-9 (July, 1958).

Measurements were made of the Hall coefficient and resistivity of a number of specimens of compressed cadmium oxide powder both during and after various heat treatments. The results are explained by assuming that during such heat treatments there may be changes in the intercrystalline resistances and also in the carrier concentration of the microcrystals. In particular it is suggested that the very large change of resistance during sintering is mainly due to a change in intercrystalline resistances. A manner by which the carrier concentration of a specimen may be changed after heavy sintering is described. A.

537.311.33 : 538.63

4972. INVESTIGATION OF THE LONGITUDINAL AND TRANSVERSE GALVANOMAGNETIC EFFECT IN N-TYPE SINGLE-CRYSTAL GERMANIUM FOR THE PRINCIPAL CRYSTALLOGRAPHIC AXES. R.G.Annaev and A.Allanazarov.
Dokl. Akad. Nauk SSSR, Vol. 118, No. 1, 47- 50 (1958). In Russian.

This investigation was made on spheres, 33.25 mm dia., cut from single-crystal germanium rods of high purity (10^{-8}%) prepared by pulling from the melt in vacuo. Spheres were orientated so that the three major directions [100], [110], [111] in a {110} plane were available. In this way the possibility of non-uniformity in specimens cut from different parts of a single crystal was overcome. It was found that for weak fields $\Delta R/R = bH^2$ (as for ferromagnetic crystals of cubic symmetry). Graphs are plotted of $\Delta R/R = f(H)$ and $\Delta R/R = f(H^2)$ for values of H from 0 to 3000 Oe. Values of b were obtained for the principal axes and with the field parallel and normal to the current flow. $\Delta R/R$ is also plotted against the angle φ between $\vec{I}$ and $\vec{H}$ in the {110} plane for all three axes and a constant field of 2426 Oe. All measurements were made at 302° K.
W.Bardsley

537.311.33

4973. ELECTRICAL PROPERTIES OF NICKEL DOPED GERMANIUM AT LOW TEMPERATURES. Y.Kanai and R.Nii.
J. Phys. Soc. Japan, Vol. 12, No. 2, 125-33 (Feb., 1957).

To study the anomalous phenomena of so-called impurity band conduction in semiconductors, the electrical properties of nickel-doped p- and n-type germanium were measured from room temperature to liquid air temperature. The energy differences between nickel levels and the edges of conduction and valence bands are so large that anomalous behaviour was found in the temperature range of liquid air. A systematic study was made for samples with different carrier concentration in nickel levels, and it is concluded that Hung's model explains qualitatively the systematic change of the electrical properties of these samples. But to understand the experimental facts quantitatively, further investigation is needed. A.

537.311.33 : 621.315.59

4974. MAJORITY CARRIER LIFETIME IN COPPER DOPED GERMANIUM AT 20° K. D.A.H.Brown.
J. Electronics and Control, Vol. 4, No. 4, 341-9 (April, 1958).

The time constant for recombination of a hole with a negatively charged copper impurity centre in germanium at 20° K was derived from experimental data from two independent methods based on measurement of (a) the photoconductive sensitivity and (b) the semiconductor shot noise. Both methods give good agreement in order of magnitude, but the theoretical values are several orders of magnitude greater. In the range of copper concentration used (2×10^{14} to 5×10^{15} cm^{-3}) the recombination time constants should decrease as the impurity concentration rises; this is not observed. A.

537.311.33 : 535.39

4975. MODULATION OF LIGHT REFLECTED FROM GERMANIUM BY INJECTED CURRENT CARRIERS. I.Filiński.
Phys. Rev., Vol. 107, No. 4, 1193 (Aug. 15, 1957).

A sine-wave voltage applied to a germanium diode gave rise to a modulation of the reflected light, with a modulation depth $\Delta R/R$ of up to 0.5%. Two extreme types of spectral distribution were observed. Type A, corresponding to a modulation of strong absorption in the short-wavelength region, occurred in point-contact diodes. In type B, modulation only occurred beyond the absorption edge and was characteristic of junction diodes with the reflecting surface opposite the indium-doped region. B.T.M.Willis

537.311.33 : 535.39

4976. CONTRIBUTION OF CURRENT CARRIERS IN THE REFLECTION OF LIGHT FROM SEMICONDUCTORS.
L.Sosnowski.
Phys. Rev., Vol. 107, No. 4, 1193-4 (Aug. 15, 1957).

The Filiński effect (see the preceding abstract) is interpreted as being due to the influence of current carriers on the refractive index, with the modulation taking place in the region of either surface or internal p—n junctions. The quantitative theory requires a knowledge of the oscillator strength and damping constants over the entire range of the absorption spectrum. B.T.M.Willis

537.311.33

4977. MAGNETORESISTANCE SYMMETRY RELATION IN N-GERMANIUM. C.Goldberg and W.E.Howard.
Phys. Rev., Vol. 110, No. 5, 1035-9 (June 1, 1958).

Careful measurement of the weak-field magnetoresistance coefficients of n-germanium indicates that the magnetoresistance symmetry relation is obeyed for samples with carrier concentrations as high as 6×10^{15} cm^{-3}. For a 3×10^{16} sample, the deviation, if any, is still quite small. For samples with carrier concentrations of 4×10^{17}, 1×10^{18}, and 1×10^{19}, there is definite evidence of deviation but there is no evidence of the large deviations previously reported. The values of the anistropy parameter K obtained from these measurements are in agreement with values previously obtained from magnetoconductance measurements. A.

537.311.33

4978. ELECTRICAL PROPERTIES OF CLEAN GERMANIUM SURFACES. G.A.Barnes and P.C.Banbury.
Proc. Phys. Soc., Vol. 71, Pt 6, 1020-1 (June, 1958).

Flat surfaces of germanium crystals (12 ohm cm n-type and intrinsic) were revealed by cleaving under a vacuum of 10^{-10} mm Hg obtained by means of an Alpert-type of system. Field effect studies and recombination velocity measurements made on these surfaces have not shown the long time-constant relaxation effects attributed to slow surface states, and results indicated a surface barrier height < 2 kT on the intrinsic material and no inversion layer on the n-type specimens. C.A.Hogarth

537.311.33 : 539.2 : 621.315.59

4979. ANISOTROPIC DIFFUSION LENGTHS IN GERMANIUM AND SILICON CRYSTALS CONTAINING PARALLEL ARRAYS OF EDGE DISLOCATIONS. R.L.Bell and C.A.Hogarth.
J. Electronics and Control, Vol. 3, No. 5, 455-70 (Nov., 1957).

Techniques for introducing parallel arrays of edge dislocations into germanium and silicon by means of plastic bending are described. Crystals of germanium with a similar arrangement of dislocations, but with a higher mean minority carrier lifetime than for those subjected to plastic bending, may be grown by pulling from the melt using a suitably orientated dislocated seed crystal. In crystals containing parallel arrays of edge dislocations the diffusion length is no longer independent of direction but is greater when measured along the dislocations than across them. The model used to explain the results suggests that the anisotropies observed will be more marked for crystals in which the dislocations are highly polygonized. A.

537.311.33 : 538.22

4980. THE MAGNETIC SUSCEPTIBILITY AND EFFECTIVE MASS OF THE CURRENT CARRIERS IN SILICON AND GERMANIUM. D.Geist.
Naturwissenschaften, Vol. 45, No. 2, 33-4 (1958). In German.

The effective mass is here calculated from the carrier density and from that part of the magnetic susceptibility which can be ascribed to the free current carriers. This small fraction of the total susceptibility is derived by measurements on samples having a range of impurity concentrations. The method enables the effective masses to be calculated at definite temperatures and it is found that the values in general increase with temperature. K.W.Plessner

537.311.33 : 621.382 : 621.315.59

4981. THE EFFECTS OF NEUTRON IRRADIATION ON GERMANIUM AND SILICON. G.C.Messenger and J.P.Spratt.
Proc. Inst. Radio Engrs, Vol. 46, No. 6, 1038-44 (June, 1958).

The known effects of neutron irradiation upon majority and minority carrier properties of germanium and silicon are reviewed, and used as a basis to derive a theoretical expression for the dependence of grounded-emitter current gain of a transistor upon accumulated neutron dose. This theoretical expression assumes a Shockley–Read recombination mechanism in the base of the transistor; the crystal defects introduced by bombardment act as recombination sites. A number of germanium and silicon transistors were irradiated at different facilities; the observed changes in transistor parameters are explained in terms of the theory. This explanation enables determination for germanium of certain basic quantities in recombination theory: the position in the forbidden band of the recombination site (E_c-E_t = 0.23 eV), and the capture cross-section of the site for hole and electron capture ($\sigma_p = 1.0 \times 10^{-15}$ cm^2, and $\sigma_n \cong 4 \times 10^{-15}$ cm^2). A.

537.311.33 : 621.315.59

4982. PROPERTIES OF SILICON AND GERMANIUM. II. E.M.Conwell.
Proc. Inst. Radio Engrs, Vol. 46, No. 6, 1281-300 (June, 1958).

For Pt I, see Abstr. 851 (1953). This paper attempts to bring up to date the information on fundamental properties of silicon and germanium. Much the same topics are covered as in the author's earlier article. Also included is some of the detailed knowledge on the band structure which has been obtained since 1952. This is essential to the understanding of many of the properties of these materials. A.

537.311.33 : 538.63

4983. MAGNETORESISTANCE AND FIELD DEPENDENCE OF THE HALL EFFECT IN INDIUM ANTIMONIDE. G.Fischer and D.K.C.MacDonald.
Canad. J. Phys., Vol. 36, No. 5, 527-38 (May, 1958).

This semiconductor has charge carriers with sufficiently long mean free paths l that it is possible, even at room temperature and with available magnetic fields, to obtain l/r values considerably greater than unity, r being the orbital radius of a charge carrier moving in the applied magnetic field. The classical two-band theory was found to account rather well for the results up to the highest magnetic fields employed. A review of the underlying assumptions of this theory is presented, and simple formulae are derived which allow the concentrations and mobilities of both types of carriers to be calculated from the magnetic field dependence of the resistivity ρ and of the Hall constant A. The parameter Λ given by

$$\Lambda \equiv [(A - A_0)/A_0]/[(\rho - \rho_0)/\rho_0]$$

provides a useful means to check the consistency of the theory and can give some indication of the variation of the mobilities with the magnetic field. A.

537.311.33 : 538.63

4984. THE TRANSVERSE MAGNETORESISTANCE EFFECT IN INDIUM ANTIMONIDE. C.H.Champness.
J. Electronics and Control, Vol. 4, No. 3, 201-18 (March, 1958).

Measurements were made on a wide range of nearly single crystal specimens at different temperatures. While most of the results can be explained from the measured carrier concentrations and Hall mobilities, assuming lattice and impurity scattering, it is found that the magnetoresistance at liquid air temperature is larger than expected. A.

537.311.33 : 539.89

4985. PIEZORESISTIVE EFFECT IN INDIUM ANTIMONIDE. F.P.Burns and A.A.Fleischer.
Phys. Rev., Vol. 107, No. 5, 1281-2 (Sept. 1, 1957).

Room temperature measurements on the variation of resistivity of pure InSb with hydrostatic and uniaxial stress were made to determine the piezoresistive and elastoresistive coefficients of pure InSb. The results are consistent with a spherical conduction-band model. A.

537.311.33

4986. THE PURIFICATION OF INDIUM AND THE PREPARATION OF InSb WITH HIGH ELECTRONIC MOBILITY. V.M.Sergeeva and E.L.Shtrum.
Zh. tekh. Fiz., Vol. 27, No. 12, 2698-701 (1957). In Russian.

A short description of some techniques employed at the Institute of Semiconductors, Leningrad. Pure In is obtained by fractional distillation in vacuum at ~ 1200°C, with subsequent electrolysis. Some analyses are given. For coarsely polycrystalline InSb (directionally frozen under hydrogen) with 4.9×10^{16} electrons/cm^3 a mobility (μ_e) of 67 000 cm^2 V^{-1} sec^{-1} was obtained. The value of μ_e appeared to increase rather slowly for carrier concentrations $< 10^{17}$ per cm^3. C.H.L.Goodman

537.311.33 : 538.63 : 621.315.59

4987. THE TRANSVERSE MAGNETORESISTANCE EFFECT IN INDIUM ARSENIDE. C.H.Champness and R.P.Chasmar.
J. Electronics and Control, Vol. 3, No. 5, 494-9 (Nov., 1957).

Measurements were made on samples of various shapes. For a long thin sample the magnitude of this effect is considerably smaller than expected for acoustic lattice scattering. It is suggested that this result may be explained by the presence of some impurity scattering. In approximately square samples the magnitude of the magnetoresistive changes are large, being 100% or more at room temperature in a field of 10^4 G. A.

537.311.33

4988. OSCILLATORY GALVANOMAGNETIC EFFECTS IN N-TYPE INDIUM ARSENIDE. H.P.R.Frederikse and W.R.Hosler.
Phys. Rev., Vol. 110, No. 4, 880-3 (May 15, 1958).

The Hall coefficient and the resistivity of n-type InAs, measured as a function of magnetic field strength at low temperatures, reveal de Haas–van Alphen type oscillations. The period is in good agreement with theoretical predictions. An electron effective mass of the order of 0.02 m_0 is calculated from the field and termperature dependence of the amplitude. A.

537.311.33

4989. DECOMPOSITION METHOD FOR PRODUCING P–N JUNCTIONS IN InP. K.Weiser.
J. appl. Phys., Vol. 29, No. 2, 229-30 (Feb., 1958).

Local molten regions using a hot helium jet were created in InP crystals in which the volatile phosphorous escaped, leaving molten indium. The surrounding InP dissolved partially in this and on refreezing the impurity concentrations at the boundary of the recrystallized region were altered due to segregation. Using cadmium as a p-type impurity and the indium as the metallic contact, reasonable p–n junctions were produced. D.Haneman

537.311.33 : 539.217 : 621.315.59

4990. EVALUATION OF THE SURFACE CONCENTRATION OF DIFFUSED LAYERS IN SILICON. G.Backenstoss.
Bell Syst. tech. J., Vol. 37, No. 3, 699-710 (May, 1958).

It is shown that the surface concentration of electrically active impurities may be evaluated if the sheet resistivity of the layer, junction depth, impurity distribution across the layer, background resistivity and the majority carrier mobility are known. The calculations were made for several typical impurity distributions in silicon. A.

537.311.33

4991. ELECTRON-BOMBARDMENT DAMAGE IN SILICON. G.K.Wertheim.
Phys. Rev., Vol. 110, No. 6, 1272-9 (June 15, 1958).

The nature of 1 MeV electron-bombardment damage in silicon was investigated by using Hall effect, conductivity, and carrier-lifetime measurements. It is shown that the bombardment imperfections consist of sites containing at least two electrically active point defects. The connection between these sites and the energy levels in the forbidden gap found in an earlier investigation is established. The state of charge, the electron and hole-capture cross-sections, and the temperature dependence of the energy levels of these imperfections are obtained. A.

537.311.33

4992. LIFETIME IN p-TYPE SILICON. J.S.Blakemore.
Phys. Rev., Vol. 110, No. 6, 1301-8 (June 15, 1958).

By using the photoconductive decay method, lifetime was measured as a function of excess electron density in p-type silicon over the temperature range 200-400° K. The linear dependence of τ_n on Δn expected from the Shockley–Read theory of recombination is not obeyed; instead a much stronger dependence is found with minority carrier densities less than 10^{12} cm^{-3} than at larger densities. The data are discussed in terms of two separate recombinative levels of the Shockley–Read type of more complex behaviour for a single kind of centre. A.

537.311.33 : 537.533.2

FIELD EMISSION FROM SILICON. See Abstr. 4065

537.311.33

4993. THE EFFECT OF HEAT TREATMENT ON THE BULK LIFETIME OF EXCESS CHARGE CARRIERS IN SILICON. L.M.Nijland and L.J.van der Pauw.
J. Electronics and Control, Vol. 3, No. 4, 391-5 (Oct., 1957).

The effects were studied of heat treatment of silicon in the range between room temperature and 1250° C. It was found that bulk lifetime, both in p- and n-type crystals made by the floating zone method, and of n-type crystals made by the Czochralski technique, might be increased by annealing at temperatures between about 300° and 700° C. Annealing at temperatures higher than about 700° C decreased lifetime both in p- and n-type crystals. In all cases the samples were relatively slowly cooled. A.

537.311.33

4994. ON THE IMPACT IONIZATION IN THE SPACE-CHARGE REGION OF P-N JUNCTIONS. F.W.G.Rose.
J. Electronics and Control, Vol. 3, No. 4, 396-400 (Oct., 1957).

The Townsend equation for impact ionization in semiconductors applies only to the case where field current and total current are equal. This condition is not fulfilled at low voltages in the space-charge region of p-n junctions, and a more exact treatment of the impact ionization in space-charge regions is given. It is shown that a "soft" breakdown must precede the Townsend breakdown in p-n junctions. This soft breakdown may often have only a negligible effect on the characteristic, especially when it is masked by surface effects. A.

537.311.33

4995. ON IMPACT IONIZATION IN SEMICONDUCTORS. H.L.Armstrong.
J. Electronics and Control, Vol. 4, No. 4, 355-7 (April, 1958).

Rose (see preceding abstract) has pointed out that the number of carriers available for impact ionization may be greater than simple field flow theory suggests because of diffusion effects. An alternative treatment of the problem is presented. C.A.Hogarth

537.311.33 : 621.315.59

4996. IRRADIATION OF P-N JUNCTIONS WITH GAMMA RAYS: A METHOD FOR MEASURING DIFFUSION LENGTHS. R.Gremmelmaier.
Proc. Inst. Radio Engrs, Vol. 46, No. 6, 1045-9 (June, 1958).

The photovoltaic effect in p-n junctions can be used to measure the diffusion lengths of minority carriers in a semiconductor. The short-circuit current in an irradiated p-n junction is $I_k = egL$, where e is the electron charge, g the generation rate (number of electron-hole pairs per unit volume and unit time generated by the radiation), and L a quantity which equals the diffusion length if the position of the p-n junction is suitably chosen. If g is known, the diffusion length can be calculated from the short-circuit current. The generation rate can easily be calculated if the junction is irradiated by γ-rays from a Co^{60} source. The method is described. Diffusion lengths were measured in Si, GaAs and InP containing a p-n junction. In GaAs diffusion lengths up to 8 μ were measured, and up to 130 μ in InP. A.

537.311.33 : 621.315.59

4997. FORMATION OF JUNCTION STRUCTURES BY SOLID-STATE DIFFUSION. F.M.Smits.
Proc. Inst. Radio Engrs, Vol. 46, No. 6, 1049-61 (June, 1958).

The diffusion of group III and group V impurities into germanium and silicon is reviewed. Observed and possible variations of the diffusion coefficient with concentration are discussed, followed by a summary of the diffusion coefficients and of solutions to the diffusion equation. Finally, methods for the evaluation of diffused layers and diffusion techniques are described. A.

537.311.33 : 621.382

4998. A HIGH FREQUENCY GERMANIUM DRIFT TRANSISTOR BY POST ALLOY DIFFUSION. J.S.Lamming.
J. Electronics and Control, Vol. 4, No. 3, 227-36 (March, 1958).

A new technique of solid-state diffusion, called here "post alloy diffusion", is described with particular reference to the construction of a high-frequency germanium drift transistor. In this post alloy diffusion technique two or more impurities of different conductivity type are alloyed into n-type germanium to produce an alloyed p-n junction. This structure is then modified by diffusion to produce a diffused p-n junction, the graded n-type region of which is suitable to act as the base and the p-type region the emitter of a drift transistor. The construction of a transistor made by this method is described and some of the design variables are discussed. Transistors with alpha cut-off frequency in excess of 200 Mc/s, collector capacitance of 1.5 pF and base resistance of 50 ohms, have been made. A.

537.311.33 : 621.382

4999. ON THE VARIATION OF TRANSISTOR SMALL-SIGNAL PARAMETERS WITH EMITTER CURRENT AND COLLECTOR VOLTAGE. N.I.Meyer.
J. Electronics and Control, Vol. 4, No. 4, 305-34 (April, 1958).

The variation of transistor small-signal parameters as a function of emitter current and collector voltage was investigated theoretically and the results were compared with those of a parallel experimental investigation. The experimentally determined variations of the low frequency hybrid parameters were found to be in excellent agreement with the calculations, apart from the variation of h_{12} with emitter current, which showed a quantitative disagreement with the theory. Misawa's theoretical expression (Abstr. 6643/1956) for the cut-off frequency f_α was compared with the experimental results, and found to lead to a wrong dependence on the emitter current. A.

537.311.33 : 537.321 : 621.382 : 621.317.39

5000. MEASUREMENT OF TRANSISTOR THERMAL RESISTANCE. B.Reich.
Proc. Inst. Radio Engrs, Vol. 46, No. 6, 1204-7 (June, 1958).

A method of measuring the thermal resistance of transistors using the collector cut-off current as an indicator is described. A series of two steps is used to determine the overall junction-to-ambient thermal resistance. This type of arrangement is most accurate and less time consuming than the one-step over-all junction-to-ambient measurement. A.

537.311.33 : 537.321 : 621.382 : 621.317.39

5001. MEASUREMENT OF INTERNAL TEMPERATURE RISE OF TRANSISTORS. J.T.Nelson and J.E.Iwersen.
Proc. Inst. Radio Engrs, Vol. 46, No. 6, 1207-8 (June, 1958).

A method making use of the variation of alpha with temperature is described. It consists of a comparison of static characteristics taken at constant temperature by means of a low-average-power pulse technique and characteristics taken under continuous power dissipation. The advantage of the method lies in the fact that measurement is made at temperature equilibrium in the hottest portion of the transistor, and is made with current and voltage distributions essentially identical with those encountered in normal operation. A.

537.311.33 : 621.382

5002. THE EFFECTIVE EMITTER AREA OF POWER TRANSISTORS. R.Emeis, A.Herlet and E.Spenke.
Proc. Inst. Radio Engrs, Vol. 46, No. 6, 1220-9 (June, 1958).

The theoretical derivation is concerned first with the determination of an effective emitter area for a transistor with cylindrical geometry. From this it follows that out of the total emitter area only the border region in a width of one diffusion length is effective. This result is applied to a geometry of concentric emitter and base rings, each being considerably broader than two diffusion lengths. For comparing theory and experiment in such a geometry, different emitter rim-lengths are realized easily when the different base rings are connected successively with one another and the emitter rings are also treated in the same manner. Theory and experiments agree. A rigorous solution for a special three-dimensional transistor model is also given. A.

537.311.4

5003. ELECTRICAL CONDUCTION IN SOLIDS. I. INFLUENCE OF THE PASSAGE OF CURRENT ON THE CONTACT BETWEEN SOLIDS. F.P.Bowden and J.B.P.Williamson.
Proc. Roy. Soc. A, Vol. 246, No. 1244, 1-12 (1958).

The effect of passing an electric current through the interface between two contacting pieces of gold has been investigated, and it has been shown that the current can cause appreciable changes in the true area of contact between the surfaces. This phenomenon has been studied by measuring the associated alterations in the constriction resistance. (This is the resistance caused by the constriction produced in the current stream as it passes through the tiny areas of contact between the metals.) It is shown that the response of the region of contact may be explained as a result of the heat generated in this resistance by the current. For any given current there is a certain critical degree of constriction through which it will just pass without causing a permanent change in the contact region; if the current flows through a contact area which presents a constriction resistance greater than this critical value, then the heat generated will be sufficient to cause the yield pressure of the metal near the interface to fall, and the area of contact will increase accordingly. The critical constriction resistance associated with any current has been found to be inversely proportional to the magnitude of the current. The response of the contact region to short-duration pulses of current has been studied. The results show that the behaviour is independent of the length of the pulse in the range investigated (10 μsec to 10 msec). They also indicate that when a short pulse of current passes between the pieces of metal mechanical collapse will occur only if the current is sufficiently large to cause melting of the metal near the interface. It is possible to calculate the temperature in the contact region from the potential difference developed across the constriction. Calculations based on the accepted mathematical treatment indicate that mechanical collapse occurred in these experiments when the temperature at the interface was raised to about 950°C. (This is significantly below the melting point of gold, 1063°C). This result was not supported by direct examination of the specimens, which showed clear evidence of melting whenever collapse occured. It is suggested that the accepted mathematical treatment of constriction resistances may not be valid when the temperature approaches the melting point; and in Pt II (see following abstract) a new treatment, which accounts for the observed results, is derived. A.

537.311.4

5004. ELECTRICAL CONDUCTION IN SOLIDS. II. THEORY OF TEMPERATURE-DEPENDENT CONDUCTORS.
J.A.Greenwood and J.B.P.Williamson.
Proc. Roy. Soc. A, Vol. 246, No. 1244, 13-31 (1958).

The experiments in Pt I (see preceding abstract) on the behaviour of the contact between metals when large currents pass the interface have yielded results which cannot be explained by the classical theory of constriction resistances. In an attempt to provide an account of this anomalous behaviour a new mathematical treatment of the general problem of the electrical heating of conductors has been developed. This treatment gives, under the appropriate conditions, a concise derivation of all the main results of the accepted theory. The new treatment is applied to the calculation of the spatial distribution of current for a particular shape of conductor, one which is relevant to many resistance welding processes. The predictions agree accurately with experimental data obtained from the examination of a series of welds. The theory is then applied to the special case of the electrical contact between gold pieces and shown to offer an explanation of the anomalous behaviour mentioned above. Good agreement is demonstrated between the theoretical predictions and the experimental results. A.

537.311.62

5005. SKIN EFFECT IN THIN FILMS AND WIRES. B.M.Bolotovskii.
Zh. éksper. teor. Fiz., Vol. 32, No. 3, 559-65 (1957). In Russian. English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 3, 465-9 (Oct., 1957).

Equations are obtained for the skin effect in thin films and wires by using kinetic theory. A method is developed for the approximate solution of these equations which gives expressions for the impedance of thin films and wires. A.

537.312.5

5006. PHOTOELECTRIC EMISSION FROM THE VALENCE BAND IN AgBr. E.A.Taft, H.R.Philipp and L.Apker.
Phys. Rev., Vol. 110, No. 4, 876-8 (May 15, 1958).

New data on the spectral dependence of the photoelectric yield from AgBr corroborate the threshold energy near 6 eV found in early work by Fleischmann. At higher energies, the yield rises in a reasonable way to plateau values above 10^{-3} electron/incident photon. The emission is accordingly interpreted as originating in the valence band. Since the electron affinity of the crystal is then 3.5 eV and the band gap a comparable 2.5 eV, AgBr is an interesting type of photoemitter in which scattering of excited electrons by valence band electrons (as in avalanche processes) is incipient near the threshold energy. AgBr is compared to extreme examples of strong and weak valence-band scattering. A.

537.312.5

5007. PHOTOCONDUCTIVITY OF ZINC SELENIDE CRYSTALS AND A CORRELATION OF DONOR AND ACCEPTOR LEVELS IN II-VI PHOTOCONDUCTORS. R.H.Bube and E.L.Lind.
Phys. Rev., Vol. 110, No. 5, 1040-9 (June 1, 1958).

Photosensitive crystals of zinc selenide were prepared by incorporating suitable proportions of Group VII donors (e.g. bromine) and either Group I acceptors (copper or silver) or Group V acceptors (antimony or arsenic) in crystals prepared from the vapour phase. Photoconductivity phenomena characteristic of other II-VI photoconductors, such as (a) variation of photocurrent with a power of light intensity greater than unity, (b) temperature quenching of photoconductivity, and (c) infrared quenching of photoconductivity, are also found for zinc selenide. Sensitizing centres in ZnSe:Br:Cu and ZnSe:Br:Ag have levels lying at the same distance above the top of the valence band (0.6 eV) as sensitizing centres in CdSe, even though the band gap of ZnSe is 50% larger than that of CdSe. Crystals with Group V acceptors are characterized in addition by a long-wavelength spectral response, out to 1.4 microns, associated with levels lying about 1.3 eV above the top of the valence band. By a consideration of known data on the conductivity, photoconductivity, and luminescence of II-VI compounds, a consistent correlation of donor and acceptor levels in these materials is possible. A.

537.312.62

5008. ELECTRON–ELECTRON INTERACTION AND SUPER-CONDUCTIVITY. I. Z.Mikura.
J. Phys. Soc. Japan, Vol. 12, No. 6, 587-610 (June, 1957).

It is shown that an electron gas exhibits the Meissner–Ochsenfeld effect if a special type of electron–electron interaction, $e^2 s_1.s_2/r$, is assumed and if the motion of an electron is considered to obey Dirac's relativistic equation, (s_1 and s_2 are the spin operators belonging respectively to each interacting electron.) The perturbation method of statistical mechanics, when applied to this system, leads to the London equation though the coefficient is different from London's original one. The theory deals in principle about the feature at absolute zero temperature in the sense that the electron–phonon interaction is not taken into account. The penetration depth of the field calculated according to the present model is quantitatively in good agreement with experiment. The known type of electron–electron interaction due to Breit, does not lead to superconductivity even in the relativistic treatment. The proposed interaction is discussed in connection with some experimental facts, i.e. the existence of an impurity effect for the penetration depth and the smaller Knight shift in the superconducting than the normal state. A.

537.312.62

5009. SUPERCONDUCTIVITY IN THE Ni–Pd–As SYSTEM.
S.Geller and B.T.Matthias.
J. Phys. Chem. Solids, Vol. 4, No. 1-2, 156-7 (1958).

The compound $PdAs_3$ apparently becomes superconducting at about 1.5°K when alloyed with a small amount of Ni.
R.G.Chambers

537.312.62

5010. COHERENT EXCITED STATES IN THE THEORY OF SUPERCONDUCTIVITY: GAUGE INVARIANCE AND THE MEISSNER EFFECT. P.W.Anderson.
Phys. Rev., Vol. 110, No. 4, 827-35 (May 15, 1958).

Discusses the coherent states generated in the Bardeen, Cooper, and Schrieffer theory of superconductivity by the momentum displacement operator $\rho_Q = \Sigma_n \exp(iQ \cdot r_n)$. Without taking into account plasma effects, these states are like bound Cooper pairs with momentum $\hbar Q$ and energies lying in the gap, and they play a central role in the explanation of the gauge invariance of the Meissner effect. Long-range Coulomb forces recombine them into plasmons with equations of motion unaffected by the gap. Central to the argument is the proof that the non-gauge-invariant terms in the Hamiltonian of Bardeen, Cooper, and Schrieffer have an effect on these states which vanishes in the weak-coupling limit. A.

537.312.62

5011. INTERMEDIATE STATE OF SUPERCONDUCTORS: INFLUENCE OF CRYSTAL STRUCTURE.
A.L.Schawlow and G.E.Devlin.
Phys. Rev., Vol. 110, No. 5, 1011-16 (June 1, 1958).

The structure of the intermediate state was studied in tin single crystals. In the purest crystals, an anisotropy is observed which is caused by the anisotropic resistance of the normal phase. The anisotropy of the structure changes sign as the temperature is lowered because of the very large magnetoresistance of pure tin. Superconducting-normal boundary (surface) energy values for tin single crystals were measured and agree with those found earlier for polycrystalline tin samples. Boundary energy values for thallium were also measured and agree with theoretical predictions. A.

537.312.62 : 539.32

YOUNG'S MODULUS AND INTERNAL FRICTION OF SUPERCONDUCTING LEAD AND TIN. See Abstr. 4471

537.322 : 621.316.74

5012. A SEMICONDUCTING THERMOSTAT FOR OSCILLATOR CIRCUITS. E.K.Iordanishvili and L.G.Tkalich.
Zh. tekh. Fiz., Vol. 27, No. 6, 1215-20 (1957). In Russian.

A device is described, using the Peltier effect (heating and cooling) at a number of semiconductor junctions in series, to maintain an otherwise thermally isolated volume of 100 cm^3 at ~20°C for external temperatures of from −60° to +60°C. Electric power consumption in the junction circuit was ~3 W; 20-40 min were required for the establishment of thermal equilibrium. For an external temperature above +40°C, a fan was needed to cool the "hot" junctions. Metallurgical Abstracts

537.323

5013. THERMOELECTRICITY AT LOW TEMPERATURES. V. THE SUITABILITY OF LEAD AS A STANDARD REFERENCE MATERIAL. J.P.Jan, W.B.Pearson and I.M.Templeton.
Canad. J. Phys., Vol. 36, No. 5, 627-31 (May, 1958).

For previous work see Abstr. 8786 (1955). Careful experiments confirm that small amounts of impurities such as Cd, In, Sn, Bi do not affect seriously the value of the thermoelectric power of lead, which is therefore found to be suitable as a reference material.
C.A.Hogarth

537.323

5014. THERMO-ELECTRICITY AT LOW TEMPERATURES. VI. A REDETERMINATION OF THE ABSOLUTE SCALE OF THERMO-ELECTRIC POWER OF LEAD.
J.W.Christian, J.P.Jan, W.B.Pearson and I.M.Templeton.
Proc. Roy. Soc. A, Vol. 245, No. 1241, 213-21 (1958).

For Pt V, see preceding abstract. The authors determined the absolute thermoelectric power of zone-purified lead up to 18°K by direct measurements against the superconductor Nb_3Sn. The new measurements, because of the high superconducting transition temperature of Nb_3Sn, leave only the very small region between 18 and 20°K in which the Thomson heat of lead must be interpolated to join the values obtained by Borelius and co-workers in earlier work, in order to extend the new scale of absolute thermoelectric power of lead up to room temperature. The variation of the Thomson heat of lead as a function of temperature below 20°K appears to be of some intrinsic interest. A.

537.323 : 539.219

5015. THE VALENCE STATE OF METALLIC LEAD.
W.B.Pearson.
Canad. J. Phys., Vol. 36, No. 5, 631-2 (May, 1958).

Attention is drawn to the fact that the thermoelectric and resistive measurements of dilute lead alloys, containing various solute proportions (see preceding two abstracts), indicate that a homovalent impurity in lead is an atom lying in Group IV, and not in Group II.
R.Bullough

537.323 : 537.311.33 : 621.315.59

5016. A SIMPLE DERIVATION OF THE THERMOELECTRIC VOLTAGE IN A NON-DEGENERATE SEMICONDUCTOR.
F.W.G.Rose, E.Billig and J.E.Parrott.
J. Electronics and Control, Vol. 3, No. 5, 481-6 (Nov., 1957).

The thermoelectric voltage in a non-degenerate semiconductor is derived, using only such well known concepts as Fermi levels, field current, diffusion current, etc. A.

537.323

5017. MEASUREMENTS OF THE VOLUME THERMO-E.M.F. IN GERMANIUM. P.I.Baranskiĭ and V.E.Lashkarev.
Zh. tekh. Fiz., Vol. 27, No. 6, 1161-6 (1957). In Russian.

The reliability of the "hot-probe" technique was studied. Potential differences were measured between two probes, separated by a distance S, on ground or etched surfaces; the probes were Cu–constantan thermocouples so that the temperature difference ΔT between them could be simultaneously measured and the thermoelectric power α calculated. ΔT was produced either by heating one probe electrically (the "hot-probe" technique) or by superposing a general thermal gradient down the specimen; the latter method was designed to avoid the large dependence of the results of the first method on the material immediately under the "hot-probe". Measurements of α on the same etched surface by the two methods agreed well and showed that α was independent of ΔT for $0.5° < \Delta T < 20°$C. For ground surfaces the "hot-probe" techniques gave anomalously low values of α, especially with n-type Ge, for $S < 1$ mm and $\Delta T < 10°$C; however, α always had the correct sign. The anomalies were thought to be caused by a thin film of p-type material created by grinding. Metallurgical Abstracts

537.324 : 537.311.33

5018. ON THE CHOICE OF THE RATIO OF THE CROSS-SECTIONS OF THE BRANCHES OF SEMICONDUCTOR THERMO-ELEMENTS. L.S.Stil'bans.
Zh. tekh. Fiz., Vol. 28, No. 2, 262-3 (1958). In Russian.

A.F.Ioffe has shown that the efficiency of a thermoelectric cooling element is maximized when the ratio of the cross-sectional areas of the two components has a calculable value, which is ~ 1.5 for typical semiconductors. The author shows that in such a case there is only a very small reduction in efficiency if the ratio is made unity for simplicity of manufacture. K.F.Hulme

ELECTRIC DISCHARGES

537.523.3 : 621.3.015.532

5019. CORONA MEASUREMENT AND INTERPRETATION. T.W.Dakin and J.Lim.
Trans Amer. Inst. Elect. Engrs III, Vol. 76, 1059-65 (1957) = Pwr Apparatus Syst., No. 33 (Dec., 1957).

Gives a detailed and critical review of various techniques for the detection and measurement of corona discharges. Various recommendations are given in order that such measurements may become more standardized and comparable. J.D.Craggs

537.523.5

5020. THE TANBERG EFFECT. M.P.Reece.
Nature (London), Vol. 180, 1347 (Dec. 14, 1957).

A brief discussion of the mechanical effects of vapour emitted from arc cathodes in the light of the work of Robson and von Engel and of Easton, Lucas and Creedy. Mention is also made of new experimental work by the author. J.D.Craggs

537.525

5021. THEORY OF THE HIGH-FREQUENCY DISCHARGE IN GASES AT LOW PRESSURES. AN EXPERIMENTAL STUDY OF ION SOURCES OF THE HIGH-FREQUENCY TYPE. J.Salmon.
Ann. Phys. (Paris), Vol. 2, No. 11-12, 827-80 (Nov.-Dec., 1957). In French.

Gives detailed calculations relating to electron energy distributions in high frequency discharges, including the effect of elastic and inelastic collisions. Calculations of electron temperatures in terms of discharge parameters are given. There is a lengthy section on breakdown conditions, i.e. the effect of secondary coefficients (e.g. secondary emission from insulators etc.) for short mean free paths. The case of long mean free paths is discussed separately in detail. Careful comparisons between theory and experimental details are made. J.D.Craggs

537.525 : 621.387

5022. NEW EFFECTS OF AN AUXILIARY ELECTRODE ON A DISCHARGE AT LOW PRESSURE. Thong Saw Pak.
J. Electronics and Control, Vol. 3, No. 5, 471-80 (Nov., 1957).

In a mercury-vapour discharge at low pressures with a hot-wire cathode, an auxiliary electrode placed close to the cathode is found to be capable of switching the discharge on and off when its potential is changed by a very small amount. Optimum operational conditions were determined for a range of discharge parameters. An auxiliary electrode of wire gauze, suitably positioned with respect to the cathode, suppresses "low frequency"noise. A.

537.525 : 621.387.014.31

5023. THE NEGATIVE GLOW AND CATHODE SPOTS IN LOW PRESSURE ARCS. M.A.Cayless.
J. Electronics and Control, Vol. 4, No. 3, 237-59 (March, 1958).

Diffusion conditions in the negative glow (or cathode spot) of low-pressure thermionic and pool arcs are investigated. It is shown that both plasma density and potential maxima occur and the cases of planar, cylindrical and spherical symmetry are considered in detail. The ion current at the cathode can be an appreciable fraction of the electron current with an upper limit of half the ratio of the cathode fall to the ionization potential in the most favourable case. The cathode fall can exceed the anode potential by several volts in addition to the anode fall. Two modes are possible for arcs with no positive column: one in which the negative glow fills the whole inter electrode space and another in which the glow is confined to the cathode spot region and the rest of the space is filled with a dark plasma corresponding to the Faraday dark space. Investigation of the dark plasma shows that cathode spots or "lines" must form for this mode to occur. In this case the current-carrying electrons pass through the sheath dividing the two plasmas in the retarding direction and the conditions for the existence of such a sheath are derived. A.

537.525 : 535.33

5024. THE MOTION OF IONS AND THE SHAPE OF ION LINES IN THE POSITIVE DISCHARGE COLUMN. II. RADIAL MOTION OF IONS IN A LOW PRESSURE DISCHARGE.
Yu.M.Kagan and V.I.Perel'.
Optika i Spektrosk., Vol. 4, No. 1, 3-8 (1958). In Russian.

For Pt I, see Abstr. 9706 (1957). Equations are derived governing the motion of ions in a quasi-neutral plasma. These are developed with certain approximations to give line-shape equations and the possibility of experimental confirmation of the theoretical treatment is pointed out. An expression is found for the effective temperature determined from the profile of the spark lines when observed perpendicular to axis of the tube. L.Bovey

537.525 : 535.33

5025. THE MOTION OF IONS AND THE SHAPE OF ION LINES IN THE POSITIVE DISCHARGE COLUMN. III. A DIRECTED MOTION OF IONS IN A DISCHARGE AT ARBITRARY PRESSURE.
Yu.M.Kagan and V.I.Perel'.
Optika i Spektrosk., Vol. 4, No. 3, 285-8 (1958). In Russian.

An expression is derived for the ion velocity at an arbitrary pressure when the longitudinal and transverse fields, the ionization density and flow of ions to the walls are considered. A short discussion of the resultant equations is given. L.Bovey

537.525 : 535.333 : 539.19

5026. ROTATIONAL TEMPERATURES OF HYDROXYL AND NITROGEN AND CONDITIONS OF THEIR EXCITATION IN HIGH-FREQUENCY DISCHARGES OVER A WIDE RANGE OF PRESSURES.
M.Z.Khokhlov.
Optika i Spektrosk., Vol. 4, No. 4, 438-47 (1958). In Russian.

Intensity measurements over the pressure range of 5-760 mm on the bands 3064 A of OH and 3371 A of N_2 were made using flame and high-frequency (30 Mc/s) discharges in air. At high pressures the rotational temperatures coincide and this is explained by the preponderant role of thermal dissociation of water in the formation of OH. Below 100 and 66 mm Hg for the flame and high-frequency discharges respectively the rotational temperature from OH is significantly greater than that from N_2. Self-absorption effects are considered. L.Bovey

537.525

5027. ON THE QUESTION OF STRIATIONS IN INERT GASES.
A.V.Nedospasov.
Zh. tekh. Fiz., Vol. 28, No. 1, 173-7 (1958). In Russian.

A theoretical discussion of the striations is given based on the assumption that linearized equations can be used for the plasma. The results of the calculation are compared with experiment. S.F.Edwards

537.525 : 535.332

RADIATION FROM HIGH-CURRENT GAS DISCHARGES. See Abstr. 4864

537.525.4

5028. BREAKDOWN IN VACUUM. V.N.Glazanov.
Elektrichestvo, 1958, No. 3, 40-4. In Russian.

Breakdown between "conditioned" electrodes of special shape in a vacuum of 10^{-7} to 10^{-8} mm Hg depends on the rise of emission current, according to Fowler–Nordheim's formula, and therefore on the gradient at the cathode. Critical value of the gradient is 5×10^7 V/cm. Between "unconditioned" electrodes the discharge obeys Semenov–Arnal's theory. Discharge inception is determined by electron emission from the cathode according to Schottky's formula, but with a reduced work function and with a field form-factor a = 3-5. The mean breakdown gradient is 3×10^6 to 3×10^5, depending on electrode distance. Electrical Research Association

537.525.4 : 535.332

MEASUREMENTS OF RELATIVE INTENSITIES OF SPECTRAL LINES IN THE EMISSION FROM HYDROGEN AND HELIUM SPARK CHANNELS. See Abstr. 4863

537.525.5

5029. BURNING VOLTAGE OF ARCS IN HIGH VACUUM.
M.P.Reece.
Nature (London), Vol. 181, 475-6 (Feb. 15, 1958).

An empirical relation was found between arcing voltages and the physical properties of the cathode in vacuum arcs. A plot is shown of mean arcing voltage v. (boiling point × thermal conductivity) for a wide range of metals. The points for carbon, non-magnetic stainless steel and ferromagnetic materials do not lie on the otherwise smooth curve. For ferromagnetics, the deviations from the curve increase with the Curie point. For mild steel the arcing voltage drops from 33 to 16.2 V when the bulk cathode is raised in temperature (bright red heat). This is above the Curie point. See also the following abstract. J.D.Craggs

537.525.5

5030. THE ARC CATHODE. A.M.Cassie.
Nature (London), Vol. 181, 476 (Feb. 15, 1958).

Describes a new theory of the non-thermionic arc cathode processes, involving a postulated establishment of a negative space charge in the region of high current-density in the cathode, near the cathode spot. This space charge effectively lowers the work

unction (by an amount equal to 1-3 eV for copper) and so gives a ighly localized increase in electron emission. A consequence of he theory is that high cathode falls would be expected for ferromag- etic materials (see the preceding abstract). J.D.Craggs

537.525.5 : 621.387.014.31

031. THE OBSERVATION OF VAPOUR JETS FROM FIXED ATHODE SPOTS IN LOW-PRESSURE MERCURY-VAPOUR ARCS. .Müller.

Naturwissenschaften, Vol. 45, No. 3, 54-5 (1958). In German.

Very briefly describes the vapour jets emitted from cathode pots arising at "spot fixers" in mercury-vapour (mercury cathode) rcs at low pressure (current of the order of a few tens of amperes). he "hillock" raised by the vapour stream on striking the mercury urface is briefly discussed, with the aid of a photograph.

J.D.Craggs

537.525.5 : 535.331

032. DETERMINATION OF THE DEGREE OF INHOMOGENEITY N A D.C. AND A.C. ARC DISCHARGE.

.V.Dvornikova and I.M.Nagibina.

Optika i Spektrosk., Vol. 4, No. 4, 421-9 (1958). In Russian.

After a discussion of the theory underlying the method (meas- rement of the self-absorption dip of lines from low lying multiplets) xperimental details of the apparatus are given. A Fabry-Perot rossed with either a grating (d.c. arc) or prism (a.c. arc) was used. he parameter giving the degree of inhomogeneity (n) was found to e (for both the d.c. and a.c. arcs) 1.5 for Cr and Mn and 1.3 for Ca.

L.Bovey

537.525.5 : 535.331

033. DETERMINATION OF THE ATOM CONCENTRATION IN AN .C. ARC DISCHARGE FROM THE WIDTH OF SPECTRAL LINES.

M.Nagibina.

Optika i Spektrosk., Vol. 4, No. 4, 430-7 (1958). In Russian.

Based on the method of Cowan and Dieke (Abstr. 3232/1948), ogether with determinations of the inhomogeneity factor n (see the receding abstract) and known data on oscillator strengths, the atom oncentrations in Ca, Mn, Fe and Cd discharges at currents of 4, 4, 6 nd 3 amperes respectively were measured by a Fabry–Perot inter- erometric technique. L.Bovey

537.525.5 : 535.338.334

034. EXPERIMENTAL EXAMINATION OF THE HOLTSMARK HEORY OF LINE-BROADENING. P.Bogen.

Z. Phys., Vol. 149, No. 1, 62-72 (1957). In German.

Temperatures (~ 10 000°K) and electron densities (2×10^{16} - $\times 10^{17}$ cm^{-3}) were inferred from absolute intensity measurements by photographic and photoelectric methods) of the H_β line emitted rom a water-stabilized arc. Comparison of the results with Holts- hark's theory shows that the effect of the electrons and ions cannot e disregarded. R.W.Nicholls

537.525.5 : 535.331

EMISSION SPECTRA OF SPARK DISCHARGES THROUGH A IGH-PRESSURE MERCURY ARC. See Abstr. 4861

537.525.8

5035. THE INFLUENCE OF A MAGNETIC FIELD ON MOVING STRIATIONS IN GLOW DISCHARGES. A.Rutscher.

Naturwissenschaften, Vol. 45, No. 3, 54 (1958). In German.

A very brief note describing the effects of fields (0-600 gauss) n striations in neon and argon glow discharges at millimetric ressures; the striations were observed with a rotating mirror.

J.D.Craggs

537.525.8 : 536.521

TEMPERATURE DETERMINATION IN A GLOW DISCHARGE. See Abstr. 4933

X-RAYS

537.531 : 537.533.8

5036. INVESTIGATIONS OF THE DIRECTIONAL DISTRIBUTION OF THE X-RAY BREMSSTRAHLUNG [CONTINUOUS X-RADIATION]. H.Doffin and H.Kulenkampff.

Z. Phys., Vol. 148, No. 4, 496-503 (1957). In German.

The distribution in angle of the continuous radiation from a hin aluminium target was studied using an improved differential ilter technique to isolate a spectral band from 1.28 to 1.46 A. For a tube voltage of 27 kV, a weak minimum occurs at 0° to the electron eam and a maximum at 20°. At higher voltages, the maximum ends to occur at lower angles. The results are in good agreement with Sommerfeld's theory. T.Mulvey

537.531 : 539.12

5037. EXCITATION OF THE X-RAY K-RADIATION OF Ni, Cu AND Mo BY MEANS OF Po^{210} α-PARTICLES. W.Bühring and O.Haxel.

Z. Phys., Vol. 148, No. 5, 653-61 (1957). In German.

The excitation of K-radiation by means of Po^{210} α-particles was studied. The energy of the α-particles was varied by a nitrogen moderator. The K-radiation from the target material was measured by a proportional counter. The number of quanta per α-particle (5.3 MeV) was found to be 18.7×10^{-9} for nickel. This is somewhat lower than predicted by Henneberg. T.Mulvey

537.531 : 539.12 : 539.219

SCATTERING OF X-RAYS BY SOLID SOLUTIONS. See Abstr. 4461

CATHODE RAYS. POSITIVE RAYS

537.533 : 621.384.62

5038. THEORY OF THE REBATRON — A RELATIVISTIC ELECTRON BUNCHING ACCELERATOR FOR USE IN MEGAVOLT ELECTRONICS. P.D.Coleman.

J. appl. Phys., Vol. 28, No. 9, 927-35 (Sept., 1957).

Highly bunched electron beams in the 1 to 3 MeV range, having a sharply peaked velocity spectrum, represent a method of generating submillimeter waves (100 to 3000 kMc/s). In the rebatron a high energy beam is produced, in which both the current wave form and the velocity distribution function approach delta functions. Computations indicate that the emergent 1.5 MeV beam has an appreciable harmonic content up to harmonics as high as the 1000th, and has a velocity spread of 0.07% for the electrons of interest. Pulsed beam powers of the order of 10^5 W should be possible using a 3 kMc/s rebatron. A.

537.533 : 621.384.62

5039. DESIGN AND EVALUATION OF AN S-BAND REBATRON. I.Kaufman and P.D.Coleman.

J. appl. Phys., Vol. 28, No. 9, 936-44 (Sept., 1957).

A practical design is presented. An indirect experimental method of evaluating the beam obtained from the rebatron, based on measuring momenta spectra, gives very satisfactory agreement with theory. The validity of this indirect method of beam analysis is strengthened by a measurement of the ratio of the 26th beam harmonic current amplitudes under two different sets of conditions determined experimentally by momenta spectra measurements. No highly critical tolerance conditions are encountered in the investigation. A.

537.533

5040. THE ELECTROMAGNETIC INTERACTION BETWEEN TWO CROSSING ELECTRON STREAMS (WITH LORENTZ TERM). II. G.H.Joshi.

Chalmers Tekn. Högsk. Handl., No. 197, 9 pp. (1958).

For Pt I see Abstr. 7948 (1957). The effect of introducing the Lorentz term into the equations of motion is examined. For most practical electron velocities the effect of the term is found to be insignificant and can be neglected. R.C.Glass

537.533 : 621.385.833

5041. STRUCTURE IN MAGNETICALLY CONFINED ELECTRON BEAMS. H.F.Webster.

J. appl. Phys., Vol. 28, No. 12, 1388-97 (Dec., 1957).

A number of observations were made of structure changes that occur in hollow and solid electron beams which are confined by a magnetic field. These structure changes occur in both the density of the beam and the transverse velocity components of the beam electrons. The velocity components were measured by use of a pin-hole camera. Some of the results obtained are as follows. The density of electron paths in a beam may become nonuniform if there is a spread in the forward component of velocity of the electrons. This may occur either because of a spread in initial angle of the electrons or because of a potential depression in the beam. In addition, changes in beam shape and transverse velocity components of the beam electrons can occur as a result of drifting of electrons in crossed and magnetic fields, the electric fields in this case being provided by the space charge of the electrons themselves. Thin beams were found to be unstable and it has been observed that they divide into an array of vortex-like current filaments when the beam current is sufficiently high. A possible connection between this occurrence and phenomena in the aurora is suggested. A.

537.533 : 621.385.833

5042. SIMPLIFIED METHODS IN THE STATISTICAL MECHANICS OF STATIONARY ELECTRON BEAMS. B.Meltzer.
J. Electronics and Control, Vol. 3, No. 4, 355-66 (Oct., 1957).

The statistical mechanics of axially symmetrical electron beams from isotropically emitting cathodes is critically developed. Calculation of current density is reduced to the evaluation of simple integrals over a "phase-plane", of which the coordinates are respectively the forward and transverse kinetic energy of a beam electron. Applications are made to retarded and accelerated beams from secondary-emission and thermionic cathodes, to the problem of improved cathode-loading in high-vacuum devices, and to explanation of anomalously high "beam temperatures" experimentally observed in cathode-potential-stabilized, television pick-up tubes.

B.Meltzer

537.533 : 621.385.833

5043. DISCUSSION OF THE PAPER BY B.W.MANLEY, "ON THE EFFECT OF THE TRANSITION REGION UPON AN ELECTRON BEAM CONSTRAINED BY BRILLOUIN FLOW". M.Müller.
J. Electronics and Control, Vol. 3, No. 4, 401-3 (Oct., 1957).

The validity of the author's treatment of the transition region between zero and full magnetic field in Brillouin flow (Abstr. 4848/1953), is defended against Manley's criticism (Abstr. 1363/1957). Manley used solutions of the trajectory equation by Brewer, which apply only to a step-function transition.

B.Meltzer

537.533 : 538.561 : 621.385.833

5044. RIBBON BEAMS. O.Buneman.
J. Electronics and Control, Vol. 3, No. 5, 507-9 (Nov., 1957).

Presents simplified, small-signal theory of wave amplification in a limitingly thin electron sheet-beam in crossed electric and magnetic fields. Agreement is obtained with the results of solid beam theory.

B.Meltzer

537.533 : 537.222 : 621.385.16.029.6

5045. RELATIVISTIC SPACE-CHARGE FLOW. O.Buneman.
J. Electronics and Control, Vol. 3, No. 5, 509-11 (Nov., 1957).

Gold's theory of the relativistic magnetron (Abstr. 5523B/1957; J. Electronics and Control, Vol. 3, No. 1, 87-96, July, 1957) is criticized because it ignores self-magnetic forces in the electron beam, which are of same order of magnitude as relativistic effects taken into account. If the self-magnetic field is not externally neutralized, the flow is pinched and electron orbits curved. An example is given of the effect of pinching on the potential of a ribbon beam. Criticism is also directed at Gold's view (Abstr. 5524B/1957; J. Electronics and Control, Vol. 3, No. 1, 97-102, July, 1957) that the "foot" of the Hull curve for the magnetron is due to gas scattering.

B.Meltzer

537.533 : 621.385.833

5046. ON THE SPACE-CHARGE DIVERGENCE OF AN AXIALLY SYMMETRIC BEAM. E.R.Harrison.
J. Electronics and Control, Vol. 4, No. 3, 193-200 (March, 1958).

An examination is made of the assumptions customarily used in estimating the effect of space-charge in an axially symmetric beam. It is shown that, subject to certain restrictions, the assumptions are consistent with a coaxial, cylindrical conducting boundary. For small amounts of divergence in an initially parallel beam, a hyperbola solution is proposed as an alternative to the usual solution which involves a tabulated function. It is then argued that in some cases there is reason for believing that the hyperbola solution may be as good an approximation as, or better than, the usual solution, even when the divergence is not small.

A.

537.533

5047. A NON-LINEAR THEORY OF PHASE OSCILLATIONS OF ELECTRONS INDUCED BY QUANTUM RADIATION FLUCTUATIONS IN ELECTRON SYNCHROTRONS. A.N.Matveev.
Zh. éksper. teor. Fiz., Vol. 33, No. 4(10), 913-17 (1957). In Russian.

It is shown that the non-linear theory essentially corrects results of a linear theory. The non-linear theory predicts more significant electron losses and imposes upon synchrotron parameters stronger restrictions than a linear theory.

A.

537.533.1.08

5048. A SOURCE OF INACCURACY ENCOUNTERED WHEN MEASURING DRIFT VELOCITIES OF ELECTRONS IN GASES BY AN ELECTRICAL SHUTTER METHOD.
R.W.Crompton, B.I.H.Hall and W.C.Macklin.
Austral. J. Phys., Vol. 10, No. 3, 366-72 (Sept., 1957).

Attention is drawn to the precautions which must be adopted when the drift velocities of very slow electrons are to be measured by an electrical shutter method. While the experimental results (which for convenience were taken in hydrogen) show that quite serious errors may result at very low energies when the experimental conditions are unsuitably chosen, they also show that it is possible to reduce such errors to any required degree by appropriat choice of the parameters l and p. The form of the variation of the measured from the true values is in qualitative agreement with a formula given by Duncan (Abstr. 6237/1957) when discussing diffusic in relation to measurements of this type.

A.

537.533.2 : 537.581

5049. ELECTRON EMISSION IN MODERATE ACCELERATING FIELDS. D.W.Juenker.
J. appl. Phys., Vol. 28, No. 12, 1398-405 (Dec., 1957).

Investigations of Schottky emission from metals, including some recent work, are summarized and discussed. The following are some of the conclusions. The surface barrier outside a uniform metal surface can be represented accurately by a mirror-image form for distances greater than about 20 A from the surface. Patch effects can be correlated to some extent with known surface properties. The dependence of photoelectric emission on applied field is in agreement with the Fowler theory adjusted for a Schottky-type field-dependent threshold. Periodic deviations from the thermionic Schottky effect are in full agreement with the mirror-image model for the extra-surface barrier, and can be used in determining the barrier form in the immediate vicinity of the emitter surface.

A.

537.533.2 : 548.5

FIELD EMISSION FROM MERCURY WHISKERS. See Abstr. 4520

537.533.2 : 537.222

5050. EXACT ELECTRODE SYSTEMS FOR THE FORMATION OF A CURVED SPACE-CHARGE BEAM. R.J.Lomax.
J. Electronics and Control, Vol. 3, No. 4, 367-74 (Oct., 1957).

An analytical method of determining the shape of the (Pierce) electrodes required to maintain a two-dimensional space-charge beam is given, which is valid when the edge of the beam is curved. The method is applied to a solution of the space-charge equations given recently by Meltzer (Abstr. 3347/1957), in which the flow pattern is a family of arcs of concentric circles. It is found that a completely enclosed electrode system results, making it unnecessary to adopt the usual approximation of terminating the electrodes at some arbitrary distance from the beam in order to make them finite.

A.

537.533.2 : 621.385.833.032.269.1

5051. ON THE ELECTRON GUN WITH HAIRPIN CATHODE: THE INTENSITY OF EMISSION AND THE NATURE OF THE ELECTRON SOURCE. K.T.Dolder and O.Klemperer.
J. Electronics and Control, Vol. 3, No. 5, 439-54 (Nov., 1957).

The emission per unit solid angle from the hairpin emission system reaches a maximum for zonal rays when the grid bias is just large enough to prevent multiple source formation, and when the cathode-to-grid distance is of the order of one grid-aperture radius. An experimental investigation of the nature of the sources has led to the conclusion that the emission can be projected either directly from the tip of the cathode or that it passes through a cross-over or that it is drawn from a virtual cathode in which electrons have come almost to rest. Conditions leading to the formation of a virtual cathode yield the highest emission over a relatively large solid angle.

A.

537.533.3 : 621.385.833

5052. A HIGH VOLTAGE ELECTRON INJECTOR GUN FOR SYNCHROTRONS. E.W.V.Acton and K.T.W.Milne.
J. sci. Instrum., Vol. 35, No. 7, 245-7 (July, 1958).

An improved demountable electron injector gun designed primarily for use in 140 and 30 MeV synchrotrons is described. The maximum energy of injection is 100 keV; facilities for the exploration of synchrotron injection parameters are provided by micrometer control of both the radius and the injection angle of the beam. Both the cathode assembly and the anode are easily detachable for replacement and experimental purposes. Details of the gun design, its electrical characteristics, and the test apparatus are given.

A.

537.533.3 : 621.385.833.032.269.1

5053. A NOTE ON PIERCE ELECTRODE DESIGN.
B.Meltzer and A.R.Dinnis.
J. Electronics and Control, Vol. 4, No. 5, 459-60 (May, 1958).

A particular example and a general theorem of the Cauchy potential problem are invoked, to show that in Pierce gun design

nly the potential and its normal derivative on the beam boundary urface should be used in calculating the potential outside the beam. Io and Moon's method (Abstr. 512/1954) is criticized because it ises higher derivatives calculated from the values of the potential nside the beam. B.Meltzer

537.533.332

5054. OPTICAL PROPERTIES OF A DOUBLET FORMED BY TWO STRONG FOCUSING MAGNETIC LENSES. A.Septier. C.R. Acad. Sci. (Paris), Vol. 246, No. 12, 1835-8 (March 24, 1958). In French.

Two crossed quadrupole lenses can be arranged to simulate the properties of a rotationally symmetrical lens. Theoretical and experimental results are presented in support of this. Simple formulae for focal lengths are provided. A.E.I. Research Laboratory

537.533.7 : 537.534.7

5055. ENERGY LOSS OF A CHARGED PARTICLE PASSING THROUGH A LAMINAR DIELECTRIC. I. Ya.B.Faĭnberg and N.A.Khizhnyak. Zh. éksper. teor. Fiz., Vol. 32, No. 4, 883-95 (1957). In Russian. English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 4, 720-9 (Nov., 1957).

The energy losses of a uniformly moving charged particle in a laminar dielectric are considered. A general expression is obtained for the losses in the case in which the particle moves in an unbounded laminar medium or in a waveguide filled with a laminar dielectric. The polarization losses are studied in detail. An expression is derived for the spectral distribution of the parametric Cherenkov radiation. The Cherenkov radiation in the case of thin layers is studied. It is shown that division of the dielectric into layers leads to an increase of the intensity of the Cherenkov radiation. The Cherenkov radiation in a thin-layered plasma is considered. A.

537.533.8 : 539.234

5056. ELECTRON OPTICAL TRANSFER: A STUDY OF ELECTRON BOMBARDMENT OF SURFACES. L.Jacob. J. Electronics and Control, Vol. 3, No. 4, 339-54 (Oct., 1957).

Electron bombardment of thin targets of barium, strontium, sodium and caesium using a standard electron gun shows that it is possible to transfer these materials from the anode to the cathode by simple electron bombardment. Their presence was revealed by the increase in thin-film, thermionic activity of a pure strontium oxide emitter, and the subsequent changes in slope of its modulation characteristic. Threshold bombarding energies lie in the region of 200-300 V and corresponding current densities at the target are of the order of 1 mA/cm^2. Increase in beam energy to 400-600 V markedly speeds up the process. Features of such thin-film build-up include large temperature dependence and high tenacity. Emission microscope studies in the case of barium and caesium give visual evidence of the arrival at the emitter of active material only during the process of target bombardment. A mechanism to account for the transfer is proposed in which L, M or N ionization occurs on the surface of the target, followed by thermal evaporation. Such positive ions as are emitted, are directed by the electron-optical field, back towards the emitter. An application of these effects can be made to the renewal of loss of active material during operation life of oxide or other thin film emitters. A.

537.533.9 : 537.534.9

5057. THEORY OF THE VAVILOV—CHERENKOV EFFECT. B.M.Bolotovskiĭ. Uspekhi fiz. Nauk, Vol. 62, No. 3, 201-46 (1957). In Russian.

The survey of the topic by J.V.Jelley (Progr. nucl. Phys., Vol. 3, 84, 1953) emphasized the experimental side. The emphasis in the present paper is intentionally upon the theoretical aspects of the subject and it is therefore complementary to Jelley's survey. The first part deals with the Vavilov—Cherenkov effect in an isotropic medium, whilst the second half is concerned with the effect in crystals. 216 references. C.R.S.Manders

537.534

5058. A 4 MV VERTICAL ELECTROSTATIC GENERATOR AT THE PHYSICO-TECHNICAL INSTITUTE OF THE ACADEMY OF SCIENCES OF THE U.S.S.R. A.K.Val'ter and A.A.Tsygikalo. Priborȳ i tekh. Éksper., 1957, No. 4, 3-12. In Russian.

The machine was designed for nuclear work requiring an accurate knowledge of the energy of the accelerated particles (±0.05%). Two beams are available. One is used for beam measurements and stabilization, the other (up to 500 μA) for irradiation of targets. Constructional details are given. The design was completed in 1949-1950. S.Chomet

537.534 : 539.14

5059. A SOURCE OF POLARIZED NUCLEI FOR ACCELERATORS. E.K.Zavoiskiĭ. Zh. éksper. teor. Fiz., Vol. 32, No. 4, 731-5 (1957). In Russian. English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 4, 603-6 (Nov., 1957).

A possible method of obtaining beams of polarized nuclei by making use of the Lamb shift of a metastable level is described. A.

537.534.3 : 539.164.07 : 539.14

5060. APPLICATION OF NUCLEAR MAGNETIC RESONANCE TO FIELD MONITORING AND CONTROL IN MASS AND ALPHA ENERGY SPECTROMETRY. J.C.Sheffield and F.A.White. Appl. Spectrosc., Vol. 12, No. 1, 12-16 (1958).

Nuclear magnetic resonance instrumentation was applied to mass spectrometers in several arrangements of magnet field stabilization and control, and as a monitor of the relative fields of paired magnet systems. Precise measurements of the magnetic field of an alpha spectrometer were made in determining alpha particle energies by monitoring the resonance frequency with an accurate frequency meter. A.

537.534.75

5061. TRANSMISSION OF POSITIVE IONS OF LITHIUM BY THIN DEPOSITED FILMS OF ALUMINIUM. V.V.Belyakova and M.A.Mittsev. Zh. tekh. Fiz., Vol. 27, No. 4, 803-4 (1957). In Russian.

Vacuum-deposited aluminium and gold films were used. They were deposited on fine (900 apertures per 100 mm^2) copper grids. A slightly divergent Li^+ beam was obtained from a heated tungsten spiral covered with LiCl. A second tungsten source (wire) could be used to supply electrons. The ions or electrons which passed through a film were collected and then recorded by a galvanometer. The authors conclude that Li ions of 1000-2000 eV energy can penetrate aluminium to a depth of tens of atomic layers. S.Chomet

537.534.8 : 537.572

5062. THE SCATTERING COEFFICIENT OF IONS AS A FUNCTION OF THE RATIO OF MASSES OF COLLIDING PARTICLES. U.A.Arifov, A.Kh.Ayukhanov and S.V.Starodubtsev. Zh. éksper. teor. Fiz., Vol. 33, No. 4(10), 845-50 (1957). In Russian.

The double-modulation method is used to study secondary ionic emission for the case when the masses of the bombarding ions are greater than the mass of the target atoms. It is shown that when Ni is bombarded with Cs ions, Mo is bombarded with Ba ions, ions scattered at reverse angles are not observed. In the case $V_i > \varphi$ (where V_i = ionization potential, φ = work function of the target), secondary ionic emission is absent at any target temperature, while in the case $V_i < \varphi$, secondary ionic emission, which appears at high target temperatures, consists of ions diffusing from inside of the target and of ions evaporated from its surface. A.

DISCHARGE TUBES. IONIZATION. THERMIONICS

537.543 : 621.385.2

5063. TRANSIT TIME AND SPACE-CHARGE IN THE SPHERICAL DIODE. L.Gold. J. Electronics and Control, Vol. 4, No. 4, 335-40 (April, 1958).

The formalism of a time-dependent Poisson equation leads to findings for the transit time and current—voltage behaviour of the spherical diode very much reminiscent of the cylindrical structure results previously derived for both zero and finite initial electron velocities (see Abstr. 2125B/1958; J. Electronics and Control, Vol. 3, No. 6, 567-72, Dec., 1957). The effect of cathode—anode inversion is also examined. A.

537.543

5064. THE COMPLEX FORMULATION OF THE EQUATIONS FOR TWO-DIMENSIONAL SPACE-CHARGE FLOW. P.T.Kirstein. J. Electronics and Control, Vol. 4, No. 5, 425-33 (May, 1958).

The equations satisfied by an electron for congruent space-charge flow, in the presence of a magnetic field, are quoted. It is shown that if the space-charge is constant along the lines of flow, and the flow is two-dimensional, these space-charge-flow equations may be written in a very simple form using a complex variable formulation. The equations are solved for a constant magnetic field normal to the flow, and flow along conic sections is obtained. The

equations are also solved in the presence of space-charge but in the absence of magnetic fields, and exact solutions for a periodic flow, similar to periodic focusing, are obtained. It is shown that if the flow is along the level lines of a harmonic function, the complex variable formulation may also profitably be used. A solution is obtained in which the flow is along equi-angular spirals, and which may be obtained from a space-charge-limited cathode. A.

537.56/.57

5065. IONIZATION LOSSES OF HIGH-ENERGY HEAVY PARTICLES. P.V.Vavilov.
Zh. éksper. teor. Fiz., Vol. 32, No. 4, 920-3 (1957). In Russian.
English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 4, 749-51 (Nov., 1957).

Analysis and rigorous solution of the problem of ionization losses of heavy particles in "thin absorbers", i.e., absorbers in which the ionization losses are much smaller than the initial energy of the particles. A.

537.56 : 535.33.07

5066. INVESTIGATION OF A POWERFUL PULSE DISCHARGE WITH A LIMITED DIAMETER OF THE CHANNEL.
N.N.Ogurtsova and I.V.Podmoshenskii.
Optika i Spektrosk., Vol. 4, No. 4, 539-41 (1958). In Russian.

The pulse, from a circuit with 100 μF capacitance, 1.5 μH inductance and 0.12 ohm resistance and to which 3000 V were applied, was studied both spectroscopically and by examination of oscillograms of current, voltage and light output. The spectrograms showed presence of emission and absorption lines from neutral, singly- and doubly-ionized atoms from both the walls of the channel and the arc electrodes. In the 4100-5700 A region brightness temperature was found to be 32 000°K. Uses of the discharge as a light source are briefly discussed. L.Bovey

537.56

5067. THE SCALING LAWS FOR THE STABILIZED PINCH.
R.J.Bickerton and H.London.
Proc. Phys. Soc., Vol. 72, Pt 1, 116-20 (July, 1958).

The scaling laws for the stabilized pinch are derived. The recent results obtained with such discharges are considered in the light of these relations. A.

537.56

5068. THE STABILITY OF THE PINCH.
S.Chandrasekhar, A.N.Kaufman and K.M.Watson.
Proc. Roy. Soc. A, Vol. 245, No. 1243, 435-55 (1958).

The stability of a cylindrical plasma with an axial magnetic field and confined between conducting walls is investigated by solving, for small oscillations about equilibrium, the linearized Boltzmann and Maxwell equations. A criterion for marginal stability is derived; this differs slightly from the one derived by Rosenbluth (Abstr. 8727/1957 and Los Alamos Scientific Laboratory Report No. 2030, 1957) from an analysis of the particle orbits. However, Rosenbluth's principal results on the possiblity of stabilizing the pinch under suitable external conditions are confirmed. In the appendix a dispersion relation appropriate for plane hydromagnetic waves in an infinite medium is obtained; this relation discloses under the simplest conditions certain types of instabilities which may occur in plasma physics. A.

537.56 : 538.3 : 621.372.823 : 621.387

5069. CONTAINMENT OF A FULLY-IONIZED PLASMA BY RADIO-FREQUENCY FIELDS.
H.A.H.Boot, S.A.Self and R.B.R-Shersby-Harvie.
J. Electronics and Control, Vol. 4, No. 5, 434-53 (May, 1958).

A fully-ionized plasma is treated as a compressible loss free dielectric in a radio-frequency field. It is shown that there are steady forces which may be used to confine a body of dense plasma in a conducting cavity resonant in a suitable mode. In the particular case of a circular E_0 waveguide at cut-off, these forces are shown to be sufficient to contain a deuterium plasma at a particle density of 3×10^{18} per cm^3 and a temperature of 10^6 °K by means of 140 kW r.f. power at 500 Mc/s. Extrapolation to higher temperatures is discussed together with the possibilities of reduction in power requirements by operating in other modes. A.

537.56 : 537.525.5

5070. EXCITATION OF PLASMA OSCILLATIONS AND GROWING PLASMA WAVES. G.D.Boyd, L.M.Field and R.W.Gould.
Phys. Rev., Vol. 109, No. 4, 1393-4 (Feb. 15, 1958).

The presence of spatially growing waves in a low pressure mercury arc plasma traversed by a beam of electrons was demonstrated using a modulated beam. The plasma electron density was also determined from its microwave reflection coefficient. Densities obtained from these methods and probe measurements show discrepancies, which are being investigated. J.W.Sturgess

537.56

5071. ON LOW-FREQUENCY OSCILLATIONS IN THE PLASMAS OF ELECTRONEGATIVE GASES. M.V.Konyukov.
Zh. éksper. teor. Fiz., Vol. 32, No. 3, 510-14 (1957). In Russian.
English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 3, 429-32 (Oct., 1957).

The oscillations of ions in a plasma whose charged components are electrons, and positive and negative ions are considered. Two branches of low-frequency oscillations were established whose frequencies depend differently on the concentration of the charged particles. A.

537.56

5072. A ROTATING PLASMA.
V.G.Stepanov, V.F.Zakharchenko and V.S.Bezel'.
Zh. éksper. teor. Fiz., Vol. 34, No. 2, 512-13 (1958). In Russian.

It is shown that a rotating magnetic field can be used to cause a plasma to rotate, giving a centrifugal effect. An experiment on these lines is described. J.B.Sykes

537.56 : 537.311.1 : 533.7

KINETIC AND POTENTIAL ENERGIES OF AN ELECTRON GAS. See Abstr. 4794

537.56 : 535.13

RADIATION OF A PLASMA IN A MAGNETIC FIELD. See Abstr. 4841

537.562 : 537.533.1

5073. FREE PATH FORMULAE FOR THE ELECTRONIC CONDUCTIVITY OF A WEAKLY IONIZED GAS IN THE PRESENCE OF A UNIFORM AND CONSTANT MAGNETIC FIELD AND A SINUSOIDAL ELECTRIC FIELD. L.G.H.Huxley.
Austral. J. Phys., Vol. 10, No. 2, 240-5 (June, 1957).

A general free path formula is given for the drift velocity of electrons in a weakly ionized gas in a sinusoidal electric field. Most special cases of interest, including the magnetic deflection of an electron stream in a gas, are readily derivable from the general formula. The results find application in microwave and ionospheric studies of the motion of electrons in gases as well as in experiments on the magnetic deflection of an electron stream. A.

537.562 : 536.453

5074. A METHOD OF HEATING MATTER OF LOW DENSITY TO TEMPERATURES IN THE RANGE 10^5 TO 10^6 °K. F.B.Knox.
Austral. J. Phys., Vol. 10, No. 4, 565-86 (Dec., 1957).

A method of confining fully ionized gases entirely by means of an oscillating electromagnetic field is described. The gas is heated by eddy currents induced in it by the oscillating field. The special case of hydrogen of density 2.5×10^{17} atom/m^3 at a temperature of 4×10^5 °K is treated in detail. It appears practicable for the method to maintain hydrogen in this state indefinitely. A.

537.562

5075. CALCULATION OF THE DRIFT VELOCITY OF IONS IN THE ELECTRIC FIELD IN THEIR OWN GAS. V.I.Perel'.
Zh. éksper. teor. Fiz., Vol. 32, No. 3, 526-33 (1957). In Russian.
English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 3, 440-5 (Oct., 1957).

On the basis of the "pure overcharge" model proposed by Sena (Zh. éksper. teor. Fiz., Vol. 16, 734, 1946), the drift velocity of ions moving in the respective gas under the influence of an electric field is calculated as a function of the ratio of the work done by the field over the length of a free path to the mean thermal energy of the atoms. The results of the calculations are in good agreement with the experimental data for inert gases. A.

537.562

5076. THE COMPLETE MICROFIELD WITH RECIPROCAL COULOMB ACTION. G.Ecker.
Z. Phys., Vol. 148, No. 5, 593-606 (1957). In German.

A detailed theoretical study of the probability distribution of microfields in discharge plasma. The Holtsmark treatment is extended and improved. The results, shown graphically, give departures from the Holtsmark distribution particularly for high carrier densities. J.D.Craggs

537.564

5077. THE TOWNSEND IONIZATION COEFFICIENTS IN CROSSED ELECTRIC AND MAGNETIC FIELDS.
H.A.Blevin and S.C.Haydon.
Austral. J. Phys., Vol. 11, No. 1, 18-34 (March, 1958).

An expression is obtained for the first Townsend ionization

coefficient in uniform crossed electric and magnetic fields, and shown to be in better agreement with observation than previous theoretical expressions. The "equivalent pressure" concept for the effect of a transverse magnetic field on this coefficient is shown to be a valid approach to the problem, although the value for the equivalent pressure obtained in this analysis differs from the values given by earlier authors. The effect of a transverse magnetic field upon the second Townsend coefficient is discussed in greater detail than hitherto, and the possibility of differentiating by this means between the secondary processes operating is discussed. A.

537.564 : 539.1.07

5078. A SOURCE OF ERROR IN THE INTERPRETATION OF THE MEASUREMENTS OF THE SPECIFIC PRIMARY IONIZATION BY MEANS OF A WILSON CHAMBER. R.Van de Walle and J.Verhaeghe. C.R. Acad. Sci. (Paris), Vol. 245, No. 20, 1721-3 (Nov. 13, 1957). In French.

Discrepancies were reported by the authors (Abstr. 2463/1958) between Bethe—Fermi calculations and cloud chamber measurements of primary ionization by electrons in gases. Other authors' experimental values are compared here, and it is suggested that the excess ionization recorded occurs as a result of gas atoms being raised to metastable states. H_2 and He, where the excess is greatest, have metastable potential levels higher than the ionization potentials of the water or alcohol impurities present in the chamber.

D.V.Mabbs

537.564 : 537.591.8

5079. A STUDY OF THE IONIZATION PRODUCED IN VARIOUS GASES BY COSMIC RADIATION. V.F.Hess and A.W.Manning. Trans Amer. Geophys. Un., Vol. 37, No. 6, 676-8 (Dec., 1956).

To study the ionization produced in various gases by cosmic radiation, four geometrically similar brass chambers differing greatly in size were used with the Gish—Sherman ionization apparatus. Each of the chambers filled with the gas being studied was placed in an iron house with walls 10 cm thick. The residual ionization was determined by using the method of Hess. By plotting the ionization in the several chambers as ordinates and the ratio of wall area to volume as abscissae, and extrapolating for infinite volume, the amount of cosmic radiation without any secondary radiation from the walls was obtained. A.

537.564

5080. LOSS OF TWO ELECTRONS IN SINGLE COLLISIONS BETWEEN NEGATIVE HYDROGEN IONS AND MOLECULES OF GASES. Ya.M.Fogel', V.A.Ankudinov and R.E.Slabospitskii. Zh. éksper. teor. Fiz., Vol. 32, No. 3, 453-62 (1957). In Russian. English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 3, 382-90 (Oct., 1957).

The effective cross-sections for the loss of two electrons in single collisions between negative hydrogen ions and He, Ne, A, Kr and Xe atoms and H_2, N_2, and O_2 molecules were measured. The measurements were carried out in a mass spectrometer in the energy range from 5 to 40 keV. A.

537.564

5081. ELECTRON-LOSS PROBABILITIES FOR MULTIPLY-CHARGED IONS. I.S.Dmitriev. Zh. éksper. teor. Fiz., Vol. 32, No. 3, 570-5 (1957). In Russian. English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 3, 473-7 (Oct., 1957).

The electron-loss probability for fast multiply-charged ions moving in a medium is considered. It is assumed that the loss probability depends only on the ratio of ion velocity to electron orbital velocity. Using this assumption, it is possible to compute the effects of electronic interactions between fast ions and matter by summing over individual electrons of the ion. Results of calculations of the mean charge, equilibrium charge distribution, specific ionization and range in air are presented for helium, lithium, beryllium, and nitrogen ions. The computed values are found to be in good agreement with the available experimental data. A.

537.564

5082. FORMATION OF NEGATIVE H^- IONS IN ELECTRON COLLISIONS WITH HYDROGEN MOLECULES. V.I.Khvostenko and V.M.Dukel'skiĭ. Zh. éksper. teor. Fiz., Vol. 33, No. 4(10), 851-5 (1957). In Russian.

H^- ions were found to form in collisions of electrons with H_2 molecules. On the curve showing the H^- ion yield as a function of the electron energy there is a narrow maximum at 14.5 eV, the origin of which should be attributed to resonance capture of electrons by H_2 molecules. The formation of H^- ions at greater electron energies probably takes place in the form of the dissociation of H_2 molecules into positive and negative ions. A.

537.581 : 537.533.2

ELECTRON EMISSION IN MODERATE ACCELERATING FIELDS. See Abstr. 5049

537.583 : 621.385.032.213.13

5083. EFFECTS OF ELECTROLYSIS IN THE THORIUM OXIDE EMITTER. D.L.Goldwater. J. Franklin Inst., Vol. 261, No. 3, 331-42 (March, 1956).

The thorium produced by electrolysis bypasses most of the subsequent current around the oxide, so that the fraction of the total current which is effective in electrolysis is greatly reduced. A picture of the thorium oxide emitter is evolved in which the evaporation of thorium from a thin surface film is in equilibrium with the production of thorium by electrolysis of the oxide. The emitting properties are then presumably characteristic of the film; the similarity of the work function of thoria cathodes and thoriated tungsten cathodes is cited. The changes of conductivity of sintered thoria specimens due to electrolysis was measured. The behaviour is quantitatively consistent with the above model, and with the view that the ionic fraction in the practical case increases with current. End effects in a specimen, which was highly metallized by electrolysis, are interpreted in terms of liberation of oxygen by electrolysis above a critical current density. A.

537.585

5084. ION DESORPTION FROM METAL SURFACES. D.G.Bills. Phys. Rev., Vol. 107, No. 4, 994-5 (Aug. 15, 1957).

It is observed that relatively large positive ion currents can be thermally desorbed from W, Ta, and Mo surfaces even several days after bombardment of the gas-covered surface with low-energy positive nitrogen ions or electrons. No measurable ion current is desorbed if the surface has not previously been bombarded. The dependence of the desorption current on bombarding current and time, on nitrogen pressure, and on the desorption time and temperature is presented. It is postulated that ions or possibly excited neutral particles are captured in traps of several different depths on the metal surface and that as the surface temperature is increased the traps of least depth are emptied first. A.

COSMIC RAYS

537.591 : 551.594.5

5085. LARGE AURORAL EFFECT ON COSMIC-RAY DETECTORS OBSERVED AT 8 g/cm² ATMOSPHERIC DEPTH. J.R.Winckler and L.Peterson. Phys. Rev., Vol. 108, No. 3, 903-4 (Nov. 1, 1957).

A large increase in the counting rates of a single Geiger counter and an ionization chamber was observed during an intense auroral display, at 8 g/cm² atmospheric depth above Minneapolis on 1 July 1957. Information concerning the type of radiation responsible for the increase is obtained from the ratio of counting rates in ion chamber and counter (which was 1.3-1.4 during the burst excess, compered with 0.26 at the same altitude, prior to the increase); the increase could be due to protons with $\beta \cong 0.45$ at the top of the atmosphere, or to ~ 60 kV X-rays, emitted as bremsstrahlung from electrons with $\beta \cong 0.5$. This implies the presence in the auroral beam of particles much greater in velocity than the beam itself.

P.Rothwell

537.591 : 523.11

THE ORIGINS OF COSMIC RAYS. See Abstr. 4624

537.591 : 523.165

COSMIC-RAY MODULATION BY SOLAR WIND. See Abstr. 4642

537.591.1

5086. MEAN FREE PATH OF HIGH-ENERGY NUCLEONS IN THE ATMOSPHERE. L.A.Farrow. Phys. Rev., Vol. 107, No. 6, 1687-94 (Sept. 15, 1957).

An altitude-variation experiment to determine the absorption mean free path in the atmosphere of high-energy nucleons of the cosmic radiation was performed using a large ionization chamber and associated counter trays. It is estimated that the nucleons studied in this experiment range in energy from 200 to 2000 BeV, which is a higher energy region than has been investigated previously in similar experiments. The absorption mean free path for protons is found to be 125 ± 9 g/cm² and for neutrons 105 ± 8 g/cm², and the charged-to-neutral ratio is 1.54 ± 0.15. These values are in good agreement with previous altitude variation experiments. There seems to be no change in the mean free path with energy. These results are compared with the calculations of Olbert and Stora, who consider the Fermi model for nuclear interactions

with the assumption of no nucleon–antinucleon pair production and partial elasticity for the collision. It is seen that the experimental values fit fairly well into this picture. Evidence is presented for the presence of high-energy nucleons near the cores of air showers, in agreement with previous work. If a power law is fitted to the density spectrum of air showers associated with nucleons, a crude value of 0.64 may be found for the exponent. Considering the scarcity of the data on which the evaluation of this particular quantity is based, the result may be considered to be in reasonably good agreement with the only previous determination which is equal to 0.5. A.

537.591.1

5087. THE ORIGIN OF COSMIC RAYS. V.L.Ginzburg.
Uspekhi fiz. Nauk, Vol. 62, No. 2, 37-98 (1957). In Russian.

The article discusses the radical changes that were made to cosmic ray theory during 1948-50 (when, to a first approximation, the composition of the primary cosmic rays at the earth was accounted for) and 1950-53 (radioastronomical data concerning the distribution of cosmic rays in the galaxy and beyond). The four main sections are concerned with: primary cosmic rays at the earth; the magnetic retardation nature of cosmic radio-emission, and the distribution of cosmic rays in the galaxy; the motion of cosmic particles in an interstellar medium; supernovae and new stars as sources of cosmic rays. 75 refs. (33 Soviet).

C.R.S.Manders

537.591.1

5088. SPECTRUM AND POSITIVE EXCESS OF THE HARD COMPONENT IN THE (9.3-17) × 10^9 eV/c MOMENTUM RANGE AT AN ALTITUDE OF 3250 m. A.I.Alikhanyan and A.O.Vaĭsenberg.
Zh. éksper. teor. Fiz., Vol. 32, No. 3, 413-16 (1957). In Russian.
English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 3, 349-51 (Oct., 1957).

The spectral distribution of the positive excess in the hard component was measured in the (0.3-17) × 10^9 eV/c momentum range. The measurements were performed on the large spectrograph of the Alagez Laboratory at an altitude of 3.25 km. A.

537.591.1

5089. MOMENTUM SPECTRUM OF THE COSMIC RADIATION AND THE POSITIVE EXCESS IN THE (0.1-2.5) × 10^9 eV/c RANGE AT AN ALTITUDE OF 3250 m. A.O.Vaĭsenberg.
Zh. éksper. teor. Fiz., Vol. 32, No. 3, 417-22 (1957). In Russian.
English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 3, 352-7 (Oct., 1957).

The spectrum of the hard component and the spectrum of unfiltered cosmic radiation were measured at an altitude of 3.25 km with the aid of magnetic analysis. The spectral distribution of the positive excess was obtained and the contributions of the proton and meson components to the magnitude of the excess evaluated. A.

537.591.15

5090. ABOUT HIGH ENERGY INTERACTIONS IN NUCLEAR EMULSIONS. P.Ciok, T.Coghen, J.Gierula, R.Hołyński, A.Jurak, M.Mięsowicz, T.Saniewska, O.Stanisz and J.Pernegr.
Nuovo Cimento, Vol. 8, No. 1, 166-9 (April 1, 1958).

The angular distributions of particles from cosmic-ray "jets" are compared with the predictions of a model in which the two colliding nucleons are considered to radiate pions separately after the collision. A satisfactory fit with the experimental data is obtained. S.J.Goldsack

537.591.15

5091. ENERGY SPECTRUM OF μ-MESONS IN EXTENSIVE ATMOSPHERIC COSMIC RAY SHOWERS.
O.I.Dovzhenko, B.A.Nelepo and S.L.Nikol'skiĭ.
Zh. éksper. teor. Fiz., Vol. 32, No. 3, 463-6 (1957). In Russian.
English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 3, 391-3 (Oct., 1957).

The energy spectrum of μ-mesons in extensive atmospheric showers of varying primary energy was studied in the energy range from 0.3 to 3.5 BeV. The measurements were carried out at mountain altitudes. It was found that in the aforementioned energy range the energy spectrum of μ-mesons is independent of the energy of the primary particle which initiated the shower. The mean μ-meson energy decreases with the distance from the shower axis. A.

537.591.15

5092. INVESTIGATION OF THE PENETRATING COMPONENT OF ELECTRON–NUCLEAR SHOWERS BY THE DELAYED COINCIDENCE METHOD IN CONJUNCTION WITH A HODOSCOPE.
G.B.Zhdanov and A.A.Khaĭdarov.
Zh. éksper. teor. Fiz., Vol. 32, No. 4, 706-13 (1957). In Russian.
English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 4, 583-9 (Nov., 1957).

The distribution in range of slow mesons created by cosmic rays on lead and graphite nuclei at effective energies on the order of 5 BeV and higher was investigated. Some peculiarities of secondary interactions of penetrating particles of electron–nuclear showers at the same energies are also examined. A.

537.591.15 : 539.12

STATISTICAL FLUCTUATIONS OCCURRING IN ELECTRON-PHOTON CASCADES OF 1000 GeV PRIMARY ENERGY. See Abstr. 4221

537.591.2 : 551.461

ESTIMATION OF COSMIC-RAY INTENSITY CHANGE OVER THE LAST 3 MILLION YEARS. See Abstr. 4550

537.591.5

5093. THE SOLAR DAILY VARIATION OF COSMIC RAY MESON INTENSITY AT $\lambda = 52°$S. AND $\lambda = 73°$S. N.R.Parsons.
Austral. J. Phys., Vol. 10, No. 3, 387-96 (Sept., 1957).

Some preliminary results are given of an investigation of solar daily variations recorded by vertically directed meson telescopes at Hobart, Tasmania (geomagnetic latitude $\lambda = 52°$S.) and at Mawson, Antarctica ($\lambda = 73°$S.). Long-term trends in phase of the variation are found to be similar to those reported by observers in the northern hemisphere. However, a substantial and fairly consistent phase difference in local time is apparent between the two stations, and its origin is discussed. A brief discussion of pressure-correction procedures is also given. A.

537.591.5

5094. DIRECTIONAL MEASUREMENTS OF THE DAILY VARIATION OF COSMIC RAY MESON INTENSITY AT $\lambda = 73°$ S. N.R. Parsons.
Austral. J. Phys., Vol. 10, No. 4, 462-70 (Dec., 1957).

Measurements are reported of the daily variations of meson intensity at Mawson, Antarctica ($\lambda = 73°$ S), recorded by counter telescopes inclined at 45° to the vertical in each of north, east, south and west directions. The results, together with those from a vertical telescope, are examined and found to be inconsistent with an assumed common origin of the different directional variations in the interaction of an anisotropic primary radiation with the earth's dipole field. A.

537.591.5

5095. TIME VARIATIONS OF COSMIC-RAY INTENSITY. R.R.Brown.
J. geophys. Res., Vol. 61, No. 4, 639-46 (Dec., 1956).

The time variations of cosmic-ray intensity associated with a large solar flare (23 February 1956) and a period (January–March 1956) of strong solar activity are reported. A possible interpretation of these semi-regular time variations in terms of matter emanating from the sun is considered. A.

537.591.5

5096. COSMIC-RAY TRAPPING IN INTERPLANETARY SPACE. A.Beiser.
J. geophys. Res., Vol. 63, No. 1, 1-17 (March, 1958).

The existence of long-term variations in cosmic-ray intensity negatively correlated with sunspot activity, was explained by Davis (Abstr. 2217/1956) in terms of a cavity in the galactic magnetic field centered about the sun. In the present paper, it is shown that a "diamagnetic" interplanetary region, rather than a "superconducting" one, can account for the cut-off in the primary cosmic-ray rigidity spectrum, as well as for the 11-year variations. The suggested diamagnetic region is an oblate spheroid in shape, with semiaxes of roughly 5 × 10^{13} cm and 5 × 10^{14} cm, and its effective permeability of 10^{-4} implies a mean interplanetary field of about 10^{-9} G. The 11-year variations and the rigidity cut-off are analysed in detail on the basis of this model. A.

537.591.5

5097. GEOMAGNETIC COORDINATES AND COSMIC RADIATION. M.S.Vallarta, R.Gall and J.Lifshitz.
Phys. Rev., Vol. 109, No. 4, 1403-4 (Feb. 15, 1958).

An integration of the equations of motion for charged particles in the earth's magnetic field was carried out, taking into account both the eccentricity of the dipole and the magnetic quadrupole terms. Results of this integration show that at intermediate latitudes there is a marked longitude effect, and at high latitudes the shadow cone is more open, so that geomagnetic cut-offs should depend on both geomagnetic latitudes and longitudes. It is concluded, however, that corrections to the shadow cone cannot explain completely all observed discrepancies between measured and calculated values of cosmic ray cut-off momenta and intensities. P.Rothwell

537.591.5

5098. INVESTIGATION OF COSMIC RAY VARIATIONS. S.N.Vernov, Yu.I.Logachev, A.E.Chudakov and Yu.G.Shafer. Uspekhi fiz. Nauk, Vol. 63, No. 1b, 149-62 (1957). In Russian.

The following topics are discussed: variations of primary cosmic radiation; variations of multiply-charged components; the geomagnetic field at great distances from the earth and its effect on cosmic radiation; and the structure of the streams emitted by the sun etc. The use of an artificial satellite to study these and other phenomena is discussed. Also considered is the design of a simple apparatus, consisting essentially of the counter and ionization chamber, to be incorporated in a satellite for such studies. C.R.S.Manders

537.591.8 : 538.561

5099. THE ELECTROMAGNETIC EMISSION BY COSMIC PARTICLES IN THE GALAXY. A.A.Korchak. Astron. Zh., Vol. 34, No. 3, 365-70 (1957). In Russian.

The longwave component of this emission is considered. Getmantsev (Abstr. 5273/1952) and Korchak (Abstr. 7882/1952) have shown that it may be attributed to bremsstrahlung from the primary component of cosmic rays in the galactic magnetic field. They assumed that cosmic particles move in circular paths in a constant, uniform magnetic field. It is now shown that this assumption is not necessary, and the spectrum of the electromagnetic radiation is calculated assuming that the magnetic field is not uniform and that the particle trajectories are arbitrary. S.Chomet

537.591.8 : 537.564

STUDY OF THE IONIZATION PRODUCED IN VARIOUS GASES BY COSMIC RADIATION. See Abstr. 5079

MAGNETISM

538.112 : 538.22

5100. CONTRIBUTION TO THE THEORETICAL STUDY OF MOLECULAR MAGNETIC SUSCEPTIBILITIES. J.Tillieu. Ann. Phys. (Paris), Sér. 13, Vol. 2, No. 7-8, 471-97 (July-Aug., 1957). In French.

A variational method is developed to determine the components of the magnetic susceptibility tensor under the postulates that the permanent magnetic moment is zero and the system is describable by a real wave-function. It has the advantage that only the wave-function of the state studied need be known. Expanding the perturbed state ψ as $\psi = \psi_0[1 + \vec{g}.\vec{\mathcal{H}}]$, where ψ_0 is the unperturbed state and $\vec{\mathcal{H}}$ the field (assumed uniform and constant), expressions for the energy and the magnetic susceptibility tensor $\chi_{\mu\nu}$ are given in terms of the components of $\vec{g}$, which are determined to make $\chi_{\mu\nu}$ a maximum. The resulting formulae are shown to be gauge invariant thus allowing any convenient choice of origin to be made which would simplify calculations. The disadvantages of the Van Vleck formulation and the poor approximations used in previous calculations are mentioned. M.J.Kearsley

538.112 : 538.22

5101. CONTRIBUTION TO THE THEORETICAL STUDY OF MOLECULAR MAGNETIC SUSCEPTIBILITIES. J.Tillieu. Ann. Phys. (Paris), Ser. 13, Vol. 2, No. 9-10, 631-75 (Sept.-Oct., 1957). In French.

The general formulae derived in an earlier paper (see the preceding abstract), are simplified for the cases of simple product wave-functions and Heitler–London bond orbitals and used to calculate the magnetic susceptibilities of σ-bonds; particular applications being to the hydrogen molecule, C–H bonds and σ C–C bonds in various states of hybridization. General formulae for the susceptibilities of π-electron systems are applied to the double bond C=C and triple bond C≡C systems, employing different types of wave-functions (used by Slater, Heitler–London, Craig, Coulson). Tables giving the calculated susceptibilities for the hydrogen molecule and a large number of saturated and unsaturated aliphatic hydrocarbons show good agreement (all within 5%) with experimental data. M.J.Kearsley

538.113

5102. DIAMAGNETISM OF A DENSE ELECTRON GAS. G.Wentzel. Phys. Rev., Vol. 108, No. 6, 1593-6 (Dec. 15, 1957).

The theory of Coulomb interactions in a dense electron gas at zero temperature is formally simplified by the introduction of an equivalent Hamiltonian which gives the correct high-density value for the correlation energy. In the corresponding approximation, the diamagnetism of a dense electron gas is found to be the same as that of noninteracting electrons. Coupling with longitudinal sound waves, or a periodic potential, fails to produce a Meissner effect. A.

538.114

5103. HEISENBERG'S MODEL OF FERRO- AND ANTIFERRO-MAGNETISM. R.Kikuchi. Ann. Phys. (New York), Vol. 4, No. 1, 1-28 (May, 1958).

Heisenberg's model of ferromagnetism, which is better than the Ising model in taking account of the exchange coupling of electrons, is treated for various lattices, extending the author's treatment of the Ising model reported previously (Abstr. 5134/1951). The first approximation using a pair of orbitals as the fundamental cluster gives the same results as those obtained by Yvon, Nakamura, and Kastelein and van Kranendonk based on different approaches. In the second approximations, ferromagnetic states appear only for the three-dimensional lattices. The anti-Curie point does not appear, but difficulties still remain for low temperatures. It is shown that the same technique can be applied to the case of spin one and also to antiferromagnetism. A.

538.114

5104. THE HEISENBERG EXCHANGE OPERATOR FOR FERRO-MAGNETIC AND ANTIFERROMAGNETIC SYSTEMS. R.K.Nesbet. Ann. Phys. (New York), Vol. 4, No. 1, 87-103 (May, 1958).

The Heisenberg exchange operator has never been derived by methods which are applicable to the general case of arbitrary spin, although this operator has served as a starting postulate of theories of ferromagnetism and antiferromagnetism. A derivation of the Heisenberg operator, valid for the interaction of ions or atoms of arbitrary spin in a crystalline environment, is given which is intended to meet the principal theoretical objections to earlier derivations. The "exchange integral" is shown to be a linear combination of two types of terms, ordinarily of opposite sign, arising respectively from the ordinary exchange integrals in the Hartree–Fock approximation and from a superchange effect which occurs in the first order of configuration interaction corrections to the Hartree–Fock approximation. The Heisenberg exchange operator, according to the present derivation, can represent the interaction between ions or atoms in a crystal only when an unfilled shell of orthogonalized atomic orbitals remain uncombined with orbitals on other atoms in the single determinant approximation at the equilibrium internuclear distance. The formula obtained for the "exchange integral" is used to calculate the transition temperatures of the antiferromagnetic oxides MnO, FeO, NiO, and CoO. The ratios between these temperatures are shown to depend primarily on spectroscopic data for the ions, and are found to be in reasonable agreement with experimental values. A.

538.114

5105. REMARKS ON ZENER'S CLASSICAL THEORY OF THE TEMPERATURE DEPENDENCE OF MAGNETIC ANISOTROPY ENERGY. R.Brenner Phys. Rev., Vol. 107, No. 6, 1539-41 (Sept. 15, 1957).

The temperature dependence of the first anisotropy constant for nickel is calculated by averaging the local anisotropy energy over a Langevin function. Reasonably good agreement with the experimental curve is obtained for $T/\theta > 0.3$. An estimated is made of the variation of the local anisotropy constant with changes in volume. A.

538.114

5106. STATISTICS OF THE ISING FERROMAGNET. A.Levitas and M.Lax. Phys. Rev., Vol. 110, No. 5, 1016-27 (June 1, 1958).

The model of ferromagnetism proposed by Ising is treated by synthesizing a cluster treatment with the spherical model. The spherical model is used to determine approximately the molecular field acting on the cluster and the effective interactions between dipoles of the cluster. The method is applied to the square net and to the cubic lattice and the critical temperatures are obtained. The result for the square net is that $E/kT_c = 0.831$ and for the cubic lattice that $E/kT_c = 0.442$. In these results E is the energy required to change an adjacent pair of dipoles from parallel to antiparallel relative orientation. A.

538.114 : 539.14

5107. ORIENTATION OF NUCLEI IN FERROMAGNETS. W.Marshall. Phys. Rev., Vol. 110, No. 6, 1280-5 (June 15, 1958).

A theoretical discussion is given of the various orientation effects acting on nuclei in ferromagnets, and the results are compared to experimental measurements on the specific heat and the

anisotropy in the emission of γ-rays by radioactive Co^{60}. The orientation is due to an effective magnetic field which is, neglecting some small terms, the sum of one negative and four positive contributions all of which are roughly comparable. The uncertainty in the total field predicted is considerable but nevertheless rough agreement is obtained with the few experimental results at present available.

A.

538.114

5108. THEORY OF BLOCH WALL BENDING WITH STRAY FIELD EFFECT. H.D.Dietze.
Z. Phys., Vol. 149, No. 3, 276-98 (1957). In German.

The theory of Kersten (Abstr. 7536-7/1956; 2402/1957) is extended by taking account of the effect on the initial permeability of stray fields produced during Bloch wall distortion. The temperature variation of the permeability is affected by these fields; application is made to iron.

E.P.Wohlfarth

538.122 : 538.3

5109. ON FORCE-FREE MAGNETIC FIELDS.
S.Chandrasekhar and P.C.Kendall.
Astrophys. J., Vol. 126, No. 2, 457-60 (Sept., 1957).

A method of deriving the general solution of the equation curl H = aH, where a = const., is given, the solution being found as the sum of a poloidal and a toroidal vector field. Applying this solution to force-free magnetic fields between spherical boundaries, it is found that, as in the axisymmetric case, there is, quite generally, equipartition of energy between poloidal and toroidal components of the field. It is pointed out that any force-free field of this type can decay freely in a fluid without causing any motion of the fluid.

A.

538.122 : 538.3

5110. THE TOPOLOGY OF FORCE-FREE MAGNETIC FIELDS.
P.A.Sweet.
Observatory, Vol. 78, 30-2 (Feb., 1958).

For the simple case of a force-free magnetic field confined within a closed surface containing two singular points, classical surface transformation methods show that the resultant lines of force will lie on an unique set of tori.

D.R.Barber

538.22

5111. MAGNETIC SUSCEPTIBILITY OF A SINTERED ROD OF αMnS. R.Lindsay and J.J.Banewicz.
Phys. Rev., Vol. 110, No. 3, 634-7 (May 1, 1958).

The magnetic susceptibility of a sintered sample of αMnS was measured from 90°K to 550°K by an absolute Gouy method. The extrapolated susceptibility at 0°K was approximately equal to 7/10 the maximum susceptibility at the Néel point (154°K). It was not possible to fit the data above the Néel point with a unique set of Weiss–Curie constants, probably due to the persistence of short-range ordering effects above the Néel temperature. Upon using the recent Wojtowicz application of the Ising–Bethe theory, a unique set of constants, $\tilde{J}/k = -100.5$°K and $C_M = 3.57$, fitted the data satisfactorily between 175°K and 550°K. A diamagnetic correction of 58×10^{-6} per mole was applied to the data before calculating the above values. Above the Néel point the susceptibility of the sintered specimen was less than the susceptibility of a powder sample by a factor which was too large to be explained in terms of the standard correction for powders or by differences in geometry. Multiple maxima in the susceptibility which were outside the range of experimental error were noted at 144°K, 151°K, 157°K, and 167°K. When considered in conjunction with the specific heat anomalies previously detected at 139°K and 147°K, it is suggested that a change in either spin ordering or crystal structure occurs in this temperature region and is responsible for the irregular susceptibility behaviour.

A.

538.221

5112. THE APPROACH TO SATURATION AS A FUNCTION OF H^{-1} FOR PURE POLYCRYSTALLINE IRON AND NICKEL.
H.Danan.
C.R. Acad. Sci. (Paris), Vol. 246, No. 3, 401-4 (Jan. 20, 1958).
In French.

Experimental results are discussed in terms of the theory of Holstein and Primakoff (Abstr. 288/1941). The quantum expression is used for iron, whilst the classical formula is more appropriate to nickel, probably because the condition $kT \ll$ exchange energy is less well satisfied in this case. Over a limited range the results appear to fit the relation $I = I_s[1 - (a/H)]$. The reasons for this are discussed and values of the coefficient of hardness, a, are obtained in terms of the previously discussed theory.

D.J.Oliver

538.221

5113. EFFECT OF HYDROSTATIC PRESSURE AND TEMPERATURE ON THE MAGNETIC PROPERTIES OF A NICKEL–ZINC FERRITE. C.Q.Adams and C.M.Davis, Jr.
J. appl. Phys., Vol. 29, No. 3, 372-3 (March, 1958).

Magnetic properties of a nickel–zinc ferrite (15% NiO, 35% ZnO, 50% Fe_2O_3) were measured over a temperature range from 23° to 110°C at hydrostatic pressures up to 40 000 lb/in^2. The relation between the shift in Curie temperature ΔT_C and the change in pressure Δp was empirically found to be $\Delta T_C = 0.078\ (\Delta p)^{0.918}$. It is shown that if magnetic anisotropy and internal strains limit the magnetizing processes, the relation between coercive force H_C maximum flux density B_m and initial permeability μ_0 is given by $H_C = \delta B_m/\mu_0$, where δ is a proportionality constant. The experimental results obtained over the entire range of temperature and pressure verify the above relation. The value of δ is 2.56 for the ferrite investigated.

A.

538.221

5114. ON THE MAGNETIC PROPERTIES OF NICKEL-ARSENIDE TYPE CRYSTALS. T.Hirone and K.Adachi.
J. Phys. Soc. Japan, Vol. 12, No. 2, 156-63 (Feb., 1957).

The formation of the ordered arrangement of the magnetic moments of cations (spin ordering or spin arrangement) in the crystal lattice of the nickel-arsenide type is studied theoretically with the molecular field approximation, taking into account interaction between pairs of cations, which form the first, second or third neighbours in the crystal lattice. Various types of spin arrangement in this structure with two kinds of cations are derived. Based on the results obtained the magnetic properties of the compounds are discussed. The theory is applied as a typical example to the interpretation of the magnetism of the ternary solid solution of manganese–chromium–antimony system.

A.

538.221

5115. ANTIFERROMAGNETISM OF $CuF_2 \cdot 2H_2O$ AND MnF_2.
R.M.Bozorth and J.W.Nielsen.
Phys. Rev., Vol. 110, No. 4, 879-80 (May 15, 1958).

The molar susceptibility, χ_m, of $CuF_2 \cdot 2H_2O$ was measured from T = 1.3 to 260°K. It is antiferromagnetic with a Néel point of $\theta_N = 26$°K. Above $T = \theta_N$ the Curie–Weiss law, $\chi_m = C_m/(T-\theta_p)$, is obeyed with $\theta_p = -37$°K and $\mu_{eff} = 1.9$. Data for MnF_2 also show antiferromagnetism with $\theta_N = 47$°, and with $C_m = 3.10$, $\theta_p = 8$°, and $\mu_{eff} = 5.0$ above the Néel point.

A.

538.221

5116. ORIGIN OF MAGNETIC ANISOTROPY IN COBALT-SUBSTITUTED MAGNETITE. J.C.Slonczewski.
Phys. Rev., Vol. 110, No. 6, 1341-8 (June 15, 1958).

The large part of the ferromagnetic anisotropy of $Co_xFe_{3-x}O_4$ attributed to the presence of Co^{2+} is explained, for small x, by means of a one-ion model. The residual orbital angular momentum $\alpha(\cong 1)$ of Co^{2+} is constrained by the crystal electric field to lie parallel to the axis of trigonal symmetry. Spin–orbit energy $\lambda \mathbf{L} \cdot \mathbf{S}$ couples the spin to this axis, accounting for the anisotropy energy. By fitting the theory to cubic anisotropy data one finds $\alpha\lambda = -132\ cm^{-1}$. The assumption that cations are mobile at higher temperatures leads to a quantitative explanation of the annealing-induced anisotropy energy. The mean orbital magnetic moment μ_L of Co^{2+} is predicted to be large ($\mu_L \cong 0.5$ Bohr magneton) and anisotropic ($\Delta\mu_L \cong 0.1$ Bohr magneton) at low temperatures.

A.

538.221 : 537.533.7

5117. THE VARIATION WITH TEMPERATURE OF THE MAGNETIC LEAKAGE FIELD IN COBALT.
M.Blackman and E.Grünbaum.
Proc. Roy. Soc. A, Vol. 245, No. 1242, 408-16 (1958).

The variation with temperature of the magnetic leakage field of an unmagnetized crystal of hexagonal cobalt was investigated by means of an electron beam. Both the prism and hexagonal faces were examined in the temperature range from 20 to 380°C by a new method using a divergent electron beam. In addition, the prism face was studied from 20°–170°C. It was found that the strength of the magnetic leakage field decreased steadily with increasing temperature. It became negligible at about 260°C and this condition persisted up to 380°C. It was also found that the basic domain spacings did not change during heating or cooling of the crystal.

A.

538.221

5118. THE INFLUENCE OF MAGNETIC VISCOSITY ON THE FREQUENCY CHARACTERISTICS OF FERRITES.
R.V.Telesnin and A.G.Shishkov.
Zh. éksper. teor. Fiz., Vol. 33, No. 4(10), 839-44 (1957). In Russian.

An investigation is made of the magnetic viscosity of a series of nickel–zinc ferrites under conditions of free and induced variations of magnetization. The viscosity characteristics taken on the same samples by both methods were obtained for the first time. An estimate is given of the constant of viscosity friction. A.

538.222/.224 : 537.311.33

5119. MAGNETIC PROPERTIES OF N-TYPE SILICON.
E.Sonder and D.K.Stevens.
Phys. Rev., Vol. 110, No. 5, 1027-34 (June 1, 1958).

The magnetic susceptibility of n-type silicon samples with a wide range of donor concentrations (3×10^{16} to 3×10^{19} atoms/cm^3) was measured as a function of temperature from 3°K to 300°K. By utilizing conduction-electron concentrations obtained from Hall coefficient measurements on comparison specimens over the range from 50°K to 400°K, the contributions to the susceptibility arising from the conduction electrons and electrons trapped on donor atoms are analysed. In the upper range of temperature the diamagnetic contribution of conduction electrons is dominant and is consistent with the model of six energy minima in the conduction band. However, comparison of the squared reciprocal mass ratio with that obtained from cyclotron-resonance experiments reveals that the former is appreciably smaller than the latter (~ 8 as compared to ~ 13). As the temperature is lowered, the conduction-electron contribution becomes successively less as electrons are frozen out on donor atoms. The trapping of electrons by donors at low temperatures leads to a Curie-law paramagnetism in the specimens of higher purity, whereas in the more impure samples, deviations from Curie's law occur which are attributed to interactions between closely spaced donor centres. A.

538.222

5120. PARAMAGNETIC RESONANCE OF CHROMIUM IN GUANIDINE ALUMINUM SULPHATE.
J.M.Daniels and H.Wesemeyer.
Canad. J. Phys., Vol. 36, No. 1, 144-5 (Jan., 1958).

An investigation was made of the paramagnetic resonance spectrum of Cr^{+++} replacing Al^{+++} in ferroelectric guanidine aluminium sulphate hexahydrate at 3 cm wavelength. A monotonic decrease was observed in Stark splitting as the temperature is raised from 35°K to room temperature. The spectrum was found to be the same in several samples, and to be unaffected by polarization in a strong electric field, and by depolarization in an alternating field. J.M.Baker

538.222

5121. PARAMAGNETIC RELAXATION IN SINGLE CRYSTALS OF CERTAIN SALTS OF THE IRON GROUP ELEMENTS.
T.M.Volokhova.
Zh. éksper. teor. Fiz., Vol. 33, No. 4(10), 856-60 (1957). In Russian.

Measurements were made of the constant b/c (b is the constant of magnetic thermal capacity, c is the Curie constant) and the time of spin–lattice relaxation ρ in single crystals of certain paramagnetic salts. A dependence was found of b/c and ρ in the copper sulphates $CuSO_4.5H_2O$, $Cu(NH_4)_2(SO_4)_2.6H_2O$ and $CuK_2(SO_4)_2.6H_2O$ on the direction of the static magnetic field H with respect to the crystallographic axes. The anisotropy of b/c and ρ was not detected, in the single crystals of $MnSO_4.4H_2O$, $Mn(NH_4)_2(SO_4)_2.6H_2O$, $Fe(NH_4)(SO_4)_2$, $CrK(SO_4)_2.12H_2O$. A.

538.222

5122. EFFECT OF ENVIRONMENTAL NUCLEI IN ELECTRON SPIN RESONANCE SPECTROSCOPY.
G.T.Trammell, H.Zeldes and R.Livingston.
Phys. Rev., Vol. 110, No. 3, 630-4 (May 1, 1958).

Occasionally an electron paramagnetic resonance absorption line is accompanied by satellite lines which result from a weak magnetic dipole–dipole interaction coupling the electron spin to a neighbouring nuclear spin. The satellites correspond to a change in spin state of the neighbour nucleus concurrent with the change in spin state of the electron. Expressions for the energy levels and transition probabilities for a spin-only electron coupled to neighbouring nuclei are given. An example of atomic hydrogen in a glassy solid coupled to nearby protons is treated, and some of the more general consequences of the interaction are pointed out. A.

538.222 : 539.19 : 537.226.1

ELECTROMAGNETIC PROPERTIES OF COMPRESSED GASES.
See Abstr. 4941

538.244.2 : 621.318.4

5123. COILS FOR THE PRODUCTION OF HIGH INTENSITY PULSED MAGNETIC FIELDS. S.Foner and H.H.Kolm.
Rev. sci. Instrum., Vol. 28, No. 10, 799-807 (Oct., 1957).

The problem of producing extremely high magnetic fields is briefly reviewed in the light of modern technique. The design, performance and application of a pulsed-field system capable of more than 750 000 gauss at room temperature is described. The coil comprises a suitably supported, machined beryllium–copper helix having an inside diameter of $\frac{3}{16}$ in. and a length of about $\frac{1}{2}$ in.; it is connected directly to a 2000 μF, 3 kV bank of surge capacitors by means of a triggered-spark gap. The discharge is oscillatory with a half-period of 120 μsec. Detailed design data and performance characteristics are presented for a large range of similarly constructed coils which afford increased volume and field uniformity at a sacrifice in field intensity. A coil providing transverse access to the field and one suitable for operation in liquid helium are also described. Characteristics of less durable coils constructed of a single strip of conductor are discussed. Brief comments on applications to a broad range of solid-state experiments and some inherent limitations are presented. Finally, the production of modulated pulsed fields, unidirectional fields, and the feasibility of extending the pulse duration are discussed. A.

538.244.2 : 536.483 : 621.318.3

5124. CRYOGENIC ELECTROMAGNETS. I. FEASIBILITY STUDY.
H.L.Laquer and E.F.Hammel.
Rev. sci. Instrum., Vol. 28, No. 11, 875-8 (Nov., 1957).

Electromagnets were built for continuous operation in liquid hydrogen. A steady field of 62 000 Oe, corresponding to a power dissipation of 15 kW, was obtained in freely boiling hydrogen with a coil 5 in. long, 2.5 in. internal diameter, and 7.5 in. external diameter. Some of the mechanical, electrical, heat transfer, economical and safety problems encountered in this work are discussed. A.

538.245

5125. MICRO UNIFORMITY OF PERMANENT MAGNETS.
L.I.Mendelsohn.
J. appl. Phys., Vol. 29, No. 3, 407-8 (March, 1958).

A measurement system was developed to measure variations in the flux density normal to the pole faces of short, axially-magnetized cylindrical permanent magnets. A quartz crystal vibrated a single-turn pick-up coil to scan an area 0.028 × 0.00002 in. at a distance of 0.010 in. from the pole face. Circumferential variation of flux density was used as the uniformity criterion. For magnets compacted from powders variations may be held to be less than 4% of the average. Directional materials such as cast Alnico V show variations as high as 17%. A.

538.245

5126. THE USE OF "MAGNETIC INKS" IN DOMAIN STRUCTURE INVESTIGATION. M.Blackman.
Research, Vol. 10, No. 8, 329-30 (Aug., 1957).

Commercially available dilute magnetic inks were used to investigate domain patterns on electropolished hexagonal and prism faces of cobalt crystals. E.P.Wohlfarth

ELECTROMAGNETISM. ELECTRODYNAMICS

538.3 : 532.5

5127. ON THE EQUILIBRIUM OF AN OBLATE LIQUID SPHEROID WITH A MAGNETIC FIELD. G.Gjellestad.
Astrophys. J., Vol. 126, No. 3, 565-72 (Nov., 1957).

As an extension of an earlier investigation by Ferraro, the equilibrium of an oblate liquid uniform spheroid with a magnetic field associated with a current proportional to the distance from the axis is being studied. It is shown that such a spheroid cannot be in mechanical equilibrium. For magnetic stars, Ferraro's approximation holds well enough. A.

538.3 : 532.5

5128. MOTION OF MAGNETIC LINES OF FORCE. W.A.Newcomb.
Ann. Phys. (New York), Vol. 3, No. 4, 347-85 (April, 1958).

To relate to experimental quantities the statement that magnetic lines of force in a conducting fluid move with the fluid one can define (1) a flux-preserving velocity, such that the flux through a closed curve moving with velocity $\vec{v}$ is a constant; or (2) a line preserving velocity, such that a line, moving with velocity $\vec{v}$, which is initially a line of force, remains a line of force in the course of

its motion. It is permissible to ascribe a velocity $\vec{v}$ to a line of force if, and only if, $\vec{v} \times (\vec{E} + \vec{v} \times \vec{H}) = 0$, and it is always possible to do so. If the drift velocity v_p, i.e. $(\vec{E} \times \vec{H}/H^2)$, is not flux-preserving there may be closed curves moving with velocity v_p and a semi-exhaustive enumeration of such curves is given. A velocity may be line-preserving without being flux-preserving but not vice-versa, the necessary and sufficient condition for line-preservation being that $\vec{H} \times [\nabla \times (\vec{E} + \vec{v} \times \vec{H})] = 0$. The above considerations are extended to relativistic hydromagnetics. S.F.Edwards

538.3 : 538.122

FORCE-FREE MAGNETIC FIELDS. See Abstr. 5109-10

538.3

5129. ELECTROMAGNETIC FIELDS DUE TO CURRENT FLOWING PARALLEL TO INTERFACE OF TWO DIFFERENT MEDIA. K.Horiuchi.
J. Phys. Soc. Japan, Vol. 12, No. 2, 170-6 (Feb., 1957).

The electromagnetic fields due to line and surface current flowing in one direction parallel to an interface of two different media are investigated theoretically. Problems are dealt with by integral equations of Wiener–Hopf type, and described from a relatively general point of view. Illustrative cases of a plane wave incident upon a conducting half-plane and a uniform line-current parallel to its rim are studied in detail, and the solutions are given in integral forms. The results may be applied to practical problems. A.

538.3 : 530.145

A GEOMETRICAL THEORY OF THE ELECTROMAGNETIC FIELD. See Abstr. 4727

538.3 : 532.5 : 523.03

5130. SWEET'S MECHANISM FOR MERGING MAGNETIC FIELDS IN CONDUCTING FLUIDS. E.N.Parker.
J. geophys. Res., Vol. 62, No. 4, 509-20 (Dec., 1957).

Sweet's mechanism (Proceedings of the International Astronomical Union Symposium on Electromagnetic Phenomena in Cosmic Physics. Stockholm, 1956) for the merging of two oppositely directed magnetic fields in a highly conducting fluid is investigated in a semi-quantitative manner. It is shown that two oppositely directed sunspot fields with scales of 10^4 km could be merged by Sweet's mechanism, if brought firmly together, in about two weeks; their normal interdiffusion time would be of the order of 600 years. It is suggested that Sweet's mechanism may be of considerable astrophysical importance: it gives a means of altering quickly the configuration of magnetic fields in ionized gases, allowing a stable field to go over into an unstable configuration, subsequently converting much of the magnetic energy into kinetic energy of the fluid. A.

538.3 : 532.5 : 523.03

5131. MAGNETIC FIELDS IN A CONDUCTING FLUID SPHERE WITH VOLUME CURRENTS. K.P.Chopra.
J. geophys. Res., Vol. 62, No. 4, 573-9 (Dec., 1957).

Force-free and other equilibrium configurations of magnetic fields in a conducting fluid sphere, with volume currents flowing in the interior of the sphere, are studied. Assuming the electrical conductivity of the sphere to be infinite, the general conditions governing the force-free and other equilibrium fields are derived, and their solutions obtained. It is found that a force-free field must be a suitable combination of a poloidal and a toroidal part. The magnetic energy is equally divided in its poloidal and toroidal components. The case of finite electrical conductivity is also considered. Here, the possibility of a current distribution is explored such that the corresponding magnetic field does not decay with time. It is concluded that it is difficult to imagine a poloidal configuration of the magnetic field, whereas a purely toroidal non-decaying magnetic field is certainly possible. A.

538.3 : 532.5

5132. THE DISPERSION OF A CURRENT ON THE SURFACE OF A HIGHLY CONDUCTING FLUID. K.Stewartson.
Proc. Cambridge Phil. Soc., Vol. 53, Pt 2, 544-5 (April, 1957).

By means of an example, it is shown that if the normal component of the magnetic field is non-zero at the free boundary of a perfectly conducting fluid, then a discontinuity in the magnetic field would be dispersed instantaneously as an Alfvén wave in the fluid. It is concluded that under these conditions the tangential components must be continuous at the free boundary. M.J.Kearsley

538.3 : 532.5

5133. MAGNETOHYDRODYNAMICS. S.I.Syrovat-skiĭ.
Uspekhi fiz. Nauk, Vol. 62, No. 3, 247-303 (1957). In Russian.

The basic principles are reviewed, and all the fundamental equations are set out. The following are considered (but not with reference to Hg and other liquid metals): the propagation of small disturbances; rupture surfaces and shock waves; increase of magnetic field; the hydromagnetic dynamo; stability problems; magnetohydrodynamic turbulence. 145 references.

C.R.S.Manders

538.314 : 550.38

5134. OSCILLATIONS OF A SYSTEM OF DISK DYNAMOS. T.Rikitake.
Proc. Cambridge Phil. Soc., Vol. 54, Pt 1, 89-105 (Jan., 1958).

The behaviour of two disk dynamos coupled to one another is examined in relation to the earth's magnetic field. It is found that reversals of electric current and magnetic field occur, unlike the case of a single disk dynamo. On assuming a simple engine that drives a disk dynamo, the coupling between electromagnetism, motion and heat is discussed. A possible range of temperature fluctuation associated with a dynamo action is also estimated very roughly. A.

ELECTROMAGNETIC WAVES AND OSCILLATORS

538.56 : 537.56

5135. NON-LINEAR PHENOMENOLOGICAL THEORY OF PLASMA OSCILLATIONS. L.Gold.
J. Electronics and Control, Vol. 4, No. 3, 219-26 (March, 1958).

A transformation involving replacement of a spatial coordinate by a time coordinate leads to ready analysis of cooperative plasma interaction with the effect of collisions introduced by a phenomenological artifice. It develops that damped oscillations of a frequency $\omega/4\pi$ can arise when the condition $\omega^2 = 4\omega_p^2 - \nu^2 > 0$ prevails, ω_p being the Langmuir–Tonks angular plasma frequency, while ν is an effective collisional frequency. The important deduction of the present theory, not contained in conventional linearized treatments, is the intensity of these standing waves which is found to be augmented by collisions but at the sacrifice of efficiency. In general, increasing the current and plasma temperature tend to promote oscillation, whereas the role of plasma density is somewhat more involved with evidence of an optimal effect. The influence of a magnetic field is investigated in the no-damping limit and found to augment the resonance of the plasma while concomitantly altering the intensity in a manner indicating an optimal field strength. A.

538.56 : 537.542

5136. OBSERVATIONS ON THE EXISTENCE OF HIGH-FREQUENCY OSCILLATIONS IN AN ION SOURCE WITH A MAGNETIC GUIDE FIELD. H.Kühn.
Z. Phys., Vol. 149, No. 3, 267-75 (1957). In German.

Oscillations with frequencies varying from about 0.5 to 2.5 Mc/s were detected in argon and hydrogen at pressures $\sim 10^{-4}$ mm Hg, in an ion source whose electrode arrangement is shown. Ion currents of up to 100 μA were obtained. The oscillations are discussed in terms of plasma disturbances. J.D.Craggs

538.561 : 537.591.8

THE ELECTROMAGNETIC EMISSION BY COSMIC PARTICLES IN THE GALAXY. See Abstr. 5099

538.561 : 621.375.9

5137. AMPLIFICATION USING A PRECESSING MAGNETIC MOMENT. K.W.H.Stevens.
J. Electronics and Control, Vol. 4, No. 3, 280-4 (March, 1958).

An account is given of the analysis of an arrangement in which two tuned circuits are coupled to a precessing magnetic moment. It is shown that with $\omega_1 + \omega_2 = \omega$, where ω_1 and ω_2 are the resonance frequencies of the circuits and ω the precession frequency, useful amplification can be obtained at ω_1. In the course of the analysis the Bloch equations are solved to a higher order in approximation than is usual. A.

538.561 : 537.533 : 621.385.833

WAVE AMPLIFICATION IN RIBBON ELECTRON BEAMS. SMALL-SIGNAL THEORY. See Abstr. 5044

538.561 : 621.375.9

5138. CIRCUIT ANALOGUES OF SUHL-TYPE MASERS. K.W.H.Stevens.
J. Electronics and Control, Vol. 4, No. 3, 275-9 (March, 1958).

An account is given of the analysis of the electrical properties of two arrangements involving tuned circuits, into which energy can be fed by varying inductances with time. It is shown that under suitable conditions these circuits can be used as amplifiers. A.

538.561 : 621.373.1 : 621.375.9

5139. TWO-LEVEL SOLID-STATE MASER.
P.F.Chester, P.E.Wagner and J.G.Castle, Jr.
Phys. Rev., Vol. 110, No. 1, 281-2 (April 1, 1958).

Microwave amplification and oscillation were obtained using two-level electron-spin systems of paramagnetic defects introduced by neutron irradiation in quartz and magnesium oxide. The spin was inverted by slow passage of the magnetic field through the resonance line, and the inversion lasted for 2 msec in quartz and for 2.5 msec in MgO. Gains, varying with time, of up to 20 dB were observed. H.Motz

538.561 : 621.375.9

5140. DESIGN CONSIDERATIONS FOR CIRCULATOR MASER SYSTEMS. F.R.Arams and G.Krayer.
Proc. Inst. Radio Engrs, Vol. 46, No. 5(I), 912-13 (May, 1958).

By using a circulator in conjunction with a maser, maximum gain–bandwidth is obtained and the maser is isolated from the receiver noise. The effect of various characteristics are examined and the noise and stability requirements for low-noise system are derived. R.C.Glass

538.561 : 621.375.9 : 621.317.34

5141. SYSTEM-NOISE MEASUREMENT OF A SOLID-STATE MASER. A.L.McWhorter and F.R.Arams.
Proc. Inst. Radio Engrs, Vol. 46, No. 5(I), 913-14 (May, 1958).

By combining a low-loss S-band circulator with a solid-state maser an amplifier system with an effective input noise temperature under 25°K was constructed. The experimental arrangement used to measure the noise is described and the sources of noise in the system other than from the maser itself are considered. R.C.Glass

538.561 : 621.375.9

5142. A U.H.F. SOLID-STATE MASER. R.H.Kingston.
Proc. Inst. Radio Engrs, Vol. 46, No. 5(I), 916 (May, 1958).

A maser for frequencies around 300 Mc/s is described, in which the pump frequency is near 5300 Mc/s. The pump frequency circuit is a resonant cavity; the signal frequency circuit is of the lumped constant type made by inserting a wire loop in the plane of the r.f. magnetic field, the loop being tuned by external dielectric material. This produces only minor changes in cavity Q. Potassium cobalticyanide +0.5% chromicyanide is used for the paramagnetic material. The structure allows considerable, independent, tuning ranges to be obtained and makes full use of the whole volume of the crystal. Gains of 10 dB and bandwidths of 100 kc/s have been obtained. A.H.W.Beck

538.561 : 621.375.9

5143. TWIN CAVITY FOR NH_3 MASERS.
J.Bonanomi, J.Herrmann, J.De Prins and P.Kartaschoff.
Rev. sci. Instrum., Vol. 28, No. 11, 879-81 (Nov., 1957).

A system of two coupled cavities is described, replacing the single cavity of an NH_3 maser. Using this system the curve of the oscillation frequency against cavity temperature presents a plateau, thus reducing considerably the "pulling" effects of the cavity. A.

538.561 : 621.375.9

5144. ON OSCILLATION EQUATIONS OF A MOLECULAR GENERATOR. V.M.Faĭn.
Zh. éksper. teor. Fiz., Vol. 33, No. 4(10), 945-7 (1957). In Russian.

Using a density matrix in the proper approximation, equations were deduced to describe both stationary and non-stationary operating conditions of a molecular generator (maser). A.

538.563 : 534.232

THE EFFECT OF THE DIRECTIVITY OF A RECEIVER DEVICE ON THE MEAN INTENSITY OF A SIGNAL RECEIVED AS THE RESULT OF SCATTERING. See Abstr. 4810

538.566 : 537.533

5145. THE INTERACTION BETWEEN AN OBLIQUELY INCIDENT PLANE ELECTROMAGNETIC WAVE AND AN ELECTRON BEAM. II. H.Wilhelmsson.
Chalmers Tekn. Högsk Handl., No. 198, 30 pp. (1958).

For Pt I see Abstr. 4812 (1955). The cases of zero and finite axial fields are treated, using the relativistic equations of motion as a starting point. No restrictions are placed on the radial distribution of electron density, but final results relate mainly to the uniform radial distribution with no magnetic field, and to a Gaussian radial distribution for the case of infinite magnetic field. The coupling effects between TE and TM modes are explored in some detail. E.A.Ash

538.566 : 534.26

EQUIVALENCE RELATIONS IN DIFFRACTION THEORY. See Abstr. 4816

538.566 : 621.396.677.71

5146. RADIATION FROM A FINE SLIT TRAVERSED BY A PROGRESSIVE WAVE. J.Ernest.
C.R. Acad. Sci. (Paris), Vol. 246, No. 14, 2113-16 (April 9, 1958). In French.

A theoretical study of radiation from a slit formed by the open side of a waveguide of rectangular cross-section. The phase velocity and attenuation of the wave in the guide are calculated as functions of frequency. Under certain conditions the radiated wave becomes evanescent and an analogy with the evanescent wave in total internal reflection of light is pointed out. W.T.Welford

538.566 : 621.396.677.71

5147. AN EXPERIMENTAL STUDY OF THE RADIATION FROM A FINE SLIT TRAVERSED BY A PROGRESSIVE WAVE. J.Ernest.
C.R. Acad. Sci. (Paris), Vol. 246, No. 15, 2236-9 (April 14, 1958). In French.

The slit is formed by the open side of a rectangular section waveguide (see the preceding abstract). The polar diagram of radiation from the slit and the phase velocity along the guide were measured over the frequency range 400 to 1200 Mc/s. W.T.Welford

538.566 : 621.372.8

5148. JUNCTION OF SMOOTH FLARED WAVE GUIDES.
D.J.Leonard and J.L.Yen.
J. appl. Phys., Vol. 28, No. 12, 1441-8 (Dec., 1957).

Stevenson's general theory of electromagnetic horns or flared waveguides (Abstr. 1982/1952) is generalized to include sudden jumps in the first derivatives of the cross-sections. Thus the junction of waveguides with different flares and of arbitrary cross-sections can be treated, provided that at the junction plane the cross-sections on the two sides are identical. General expressions are derived for the reflection and transmission coefficients correct up to the second order in flare angle. Explicit results for a few configurations of practical interest are derived, including some second-order ones. In cases where special theories exist, comparisons are made with favourable results. In addition, an experimental check is performed. A.

538.566 : 621.372.822

5149. A PHYSICAL INTERPRETATION OF IMPEDANCE FOR RECTANGULAR WAVEGUIDES. L.Lewin.
Proc. Phys. Soc., Vol. 71, Pt 5, 868-9 (May, 1958).

A note giving a physical justification for the use of a particular expression for the characteristic impedance of a waveguide, in preference to certain others, differing from it by a constant factor. E.A.Ash

538.566.2

5150. ELECTROMAGNETIC PROPAGATION IN AN ALMOST HOMOGENEOUS MEDIUM. V.W.Bolie.
Austral. J. Phys., Vol. 11, No. 1, 118-25 (March, 1958).

An equation of propagation in an almost homogeneous medium is developed from Maxwell's electromagnetic equations. The equation is applied to the problem of determining the secondary wave produced by an isolated Gaussian-shaped perturbation in the refractive index. An exact solution is obtained for points located on the axis of symmetry parallel to the direction of propagation of the incident primary wave. An approximate solution for points remote from the anomaly is obtained and its validity is compared with the more restricted exact solution. An interesting limit process is encountered in the derivation of the formula for the scattering cross-section of the refractive index perturbation. A.

538.566.2 : 539.2

5151. THEORY OF ELECTROMAGNETIC WAVES IN A CRYSTAL IN WHICH EXCITONS ARE PRODUCED. S.I.Pekar.
Zh. éksper. teor. Fiz., Vol. 33, No. 4(10), 1022-36 (1957).
In Russian.

Light waves are considered whose frequency extends into the region of exciton absorption of light or close to it. A relationship is obtained between the specific dipole moment of polarization of the crystal and the electrical field strength. This relation is not a direct proportion, as was ordinarily assumed, but is expressed by a differential equation. For this reason, the Maxwell system of equations is obtained of a higher order and it has more complex solutions than the generally known solutions that follow from the simple phenomenological theory. It is shown that in a crystal there

exist several waves of the same frequency, polarization and propagation direction, but with different indexes of refraction. This phenomenon differs from double refraction of light and occurs even in isotropically polarizing (cubic) crystals. Strictly longitudinal electric waves are shown to exist in the crystal. Surface exciton states — analogues of surface electron states — are considered. A.

538.566.2

5152. A NEW SOLUTION OF THE PROBLEM OF PROPAGATION OVER A PLANE EARTH. G.Boudouris.
Nuovo Cimento Suppl. (Ser. 10), Vol. 5, No. 1, 71-91 (1957).
In French.

The classical solution of the problem gives results which can only be applied to practical problems after the introduction of numerous simplifications and approximations (e.g. it is assumed that the modulus of the complex permittivity of the earth is large compared with unity). The present author introduces a similar set of simplifications in the initial formulation of the problem as well as in the boundary conditions. The solution is now more easily obtained and while the order of accuracy is the same as that of the classical method, the approach is more susceptible of simple physical interpretation. The method is described as "the method of approximate boundary conditions", and is based on some recent (1940-1953) Russian investigations. The field within the earth could be calculated equally simply. G.D.Sims

538.566.3 : 621.396.8

5153. REFRACTIVE CORRECTIONS TO SCATTER PROPAGATION. A.D.Wheelon.
J. geophys. Res., Vol. 62, No. 3, 343-9 (Sept., 1957).

The role played by the ionosphere's mean electron density for scatter propagation is considered. An electron plasma at the scattering point (1) increases the effective wavelength and (2) decreases the scattering angle. These effects combine to modify the basic propagation variable by a factor which depends only on the instantaneous maximum usable frequency for the path. Associated signal-level variations are found to be insignificant for conventional v.h.f. scatter links. Such an analysis does provide an explanation for recent observations of F layer scattered signals and their correlation with f_p/f, where f_p is the usual penetration frequency. Apparent scattering-height changes caused by variable refractive pulse delay times are also studied. A.

538.566.3 : 621.396.8

5154. THE RELATION OF FORWARD SCATTERING OF VERY HIGH FREQUENCY RADIO WAVES TO PARTIAL REFLECTION OF MEDIUM FREQUENCY WAVES AT VERTICAL INCIDENCE. J.B.Gregory.
J. geophys. Res., Vol. 62, No. 3, 383-8 (Sept., 1957).

A comparison is made between published v.h.f. forward-scatter data and results of vertical-incidence investigations of the lower ionosphere, mainly at a frequency of 1.75 Mc/s. The received waves in each type of transmission are shown to have many similar characteristics, such as temporal variations, and to originate in the same height regions. It is concluded that the two types of transmission have a common origin. A.

538.566.3 : 621.396

5155. THE ROLE OF IONOSPHERIC-LAYER TILTS IN LONG-RANGE HIGH-FREQUENCY RADIO PROPAGATION. S.Stein.
J. geophys. Res., Vol. 63, No. 1, 217-41 (March, 1958).

An introduction to the role of ionospheric-layer tilts in long-range h.f. and v.h.f. radio propagation is given. Tilts in the reflecting layers can have a first-order effect on radio propagation as a consequence of the curvilinear geometry of the earth. Low-angle rays reflected from a properly oriented, sufficiently tilted F-layer will propagate beyond the bulge of the earth without striking the ground and illuminate the ionosphere again. When sufficient ion density exists at the second illuminated region, the rays will propagate on around the earth. A ray may be reflected several times before striking a properly oriented tilt so that the surface of the earth is illuminated. These modes are called ^nF modes, where n is the number of layer reflections. Ray trajectories for a simple ionospheric model have been derived as an example of "tilted reflection". Anticipated fading, m.u.f. and field-strength characteristics of ^nF modes are discussed. The build-up of ^nF backscatter echoes is not linked to the characteristics of thick-layer reflection and is explained in terms of "geometrical" time-delay focusing. Many different ^nF and combinations of conventional and ^nF modes have been observed on radio frequencies between 12 Mc/s and 30 Mc/s. The characteristic ranges on the different frequencies are, to first order, the same. ^nF backscatter echoes are often of high amplitude relative to conventional two-hop F-layer-propagated backscatter. At times, a complete absence of intervening ground backscatter between ground-zero and ^2F, ^3F, ^4F or ^5F echoes is observed. The times of occurrence of ^nF modes, length of each individual occurrence, direction of occurrence, and combinations of different modes are fundamentally related to the structure of the F layer and the radio frequency of observation. A.

538.566.3

5156. COUPLED FORMS OF THE DIFFERENTIAL EQUATIONS GOVERNING RADIO PROPAGATION IN THE IONOSPHERE. II. K.G.Budden and P.C.Clemmow.
Proc. Cambridge Phil. Soc., Vol. 53, Pt 3, 669-82 (July, 1957).

For Pt I see Abstr. 4752 (1954). The four first-order "coupled" equations governing the propagation of electromagnetic waves in the ionosphere, obtained in Pt I in symbolic matrix form, are expressed explicitly in terms of the ionospheric parameters. The physical significance of the equations is illustrated by considering the energy flux in one characteristic wave when coupling and damping are neglected. Three special cases are then discussed for which second-order coupled equations are also given, namely, the cases of (a) vertical incidence with oblique magnetic field, (b) oblique incidence with vertical magnetic field, (c) horizontal magnetic field in the plane of incidence. For case (a) the second-order equations are those previously derived by Försterling (1942). The form of the coupled equations is physically illuminating and, in principle, suitable for solution by successive approximations. Extensive numerical work has indeed been carried out on the second order coupled equations in case (a), and it is probable that the first-order coupled equations would prove more advantageous. The present authors, however, feel that better methods are available for purely numerical work (e.g. Budden, Abstr. 2908/1955), and that the chief interest of the coupled form is that it shows the scope and limitations of the physical conception of characteristic waves. A.

NUCLEAR AND ATOMIC PHYSICS
APPARATUS. PARTICLE DETECTORS

539.1.07

5157. SOME OBSERVATIONS ON THE BEHAVIOUR OF BROMINE QUENCHED GEIGER TUBES. R.E.Belin.
Austral. J. Phys., Vol. 10, No. 2, 263-7 (June, 1957).

A number of Geiger tubes were constructed using 18 : 8 low-carbon stainless steel and 99.9+ per cent aluminium cathodes with tungsten anodes. Plateaux improved, but threshold voltages rose 2 V/deg.C with increase in temperature. Tubes with stainless steel cathodes operated at 100°C for one week showed no deterioration. A few tubes with bromine pressures of approximately 0.01 cm Hg in a total filling of 20 cm Hg argon exhibited oscillations over an interval along the length of the plateau. During this interval the tubes were insensitive to external radiations. These tubes, as well as others with higher bromine pressures, also gave, at some defined overvoltage, Geiger pulses with extended tails, upon which 25 kc/s oscillations were superimposed. A.

539.1.07

5158. BORON TRIFLUORIDE PROPORTIONAL COUNTERS. W.Abson, P.G.Salmon and S.Pyrah.
Proc. Instn Elect. Engrs, Paper 2542M, publ. Jan., 1958 (Vol. 105B, 357-64, 365-9).

Republication, with discussion, of the paper abstracted in Abstr. 669 (1958).

539.1.07

5159. MODIFICATION OF THE BASIS FOR ROENTGEN CALIBRATIONS BETWEEN 0.5 AND 3 MeV. C.Garrett.
Canad. J. Phys., Vol. 36, No. 1, 149-50 (Jan., 1958).

From 1 January 1958 calibrations of ionization chambers in the U.S.A. and Canada (previously based on Laurence's calculated dose-rate for Ra of k = 8.4 r/hr at 1 cm from 1 mg Ra filtered by 0.5 mm Pt) will use a value k = 8.25 derived using the Bakker and Segrè stopping-power values, an average excitation potential of 80.5 eV for air, and the Sternheimer density correction. D.V.Mabbs

539.1.07

160. THE DESIGN, PERFORMANCE AND USE OF FISSION OUNTERS. W.Abson, P.G.Salmon and S.Pyrah.
roc. Instn Elect. Engrs, Paper 2546M, publ. Jan., 1958 (Vol. 105B, 49-56, 365-9).
Republication, with discussion, of the paper abstracted in bstr. 670 (1958).

539.1.07

161. PLASTIC PHOSPHOR MATRIX FOR FAST-NEUTRON ETECTION. B.Brown and E.B.Hooper, Jr.
ucleonics, Vol. 16, No. 4, 96, 98, 100, 102-3 (April, 1958).
Buttons were prepared by moulding particles of plastic cintillator in lucite or polystyrene, and the light pulses due to amma and neutron radiation compared with those from buttons ontaining ZnS, KI and NaI. At high neutron energies the plastic osphor buttons were more efficient than ZnS detectors. Good amma discrimination was obtained by using small phosphor grain-ze. R.D.Smith

539.1.07 : 537.591

162. ON THE PULSES PRODUCED BY COSMIC RAYS IN HOTOMULTIPLIERS. U.Amaldi, Jr.
uovo Cimento, Vol. 6, No. 4, 946-52 (Oct., 1957). In Italian.
The pulses produced in a photomultiplier by fast ionizing osmic-ray particles were studied by means of a coincidence rrangement through analysis of the pulse-height distributions ob-ined under various conditions. The contribution of the Cherenkov ffect in the glass of the window was clearly established through its rectional properties. The average pulse-height of a Cherenkov ulse is ~ 5 photoelectrons. An upper limit for the contribution of otropic scintillation is evaluated, and the possible contribution of e mechanism of direct extraction of electrons from the photocath-le and the dynodes is discussed. P.Rothwell

539.1.07

163. THE SIXTH SCINTILLATION COUNTER SYMPOSIUM. .A.Morton.
hys. Today, Vol. 11, No. 5, 22-3 (May, 1958).
This is a non-specialist report of the above symposium, which as held at Washington, D.C., on January 27-28, 1958. Its sponsors ere the American Institute of Electrical Engineers, the Institute of adio Engineers, the Atomic Energy Commission, and the National ureau of Standards.

539.1.07 : 539.21

EFFECT OF ELECTRON BOMBARDMENT ON COUNTING ROPERTIES OF DIAMONDS. See Abstr. 4448

539.1.07 : 537.564

A SOURCE OF ERROR IN THE INTERPRETATION OF THE EASUREMENTS OF THE SPECIFIC PRIMARY IONIZATION BY EANS OF A WILSON CHAMBER. See Abstr. 5078

539.1.07

164. NUCLEAR INSTRUMENTATION. J.Cockcroft.
Electronics and Control, Vol. 4, No. 3, 261-74 (March, 1958).

539.1.07

165. SOLID-STATE NEUTRON-FLUX MEASURING SYSTEM. .S.Gray, W.M.Grim, Jr, F.S.Replogle, Jr and R.H.Spencer.
rans Amer. Inst. Elect. Engrs I, Vol. 76, 368-72 (1957) = Commun. d Electronics, No. 31 (July, 1957).
A rugged neutron-sensitive thermopile was built from $\frac{3}{4}$ in. ameter disks, hot-pressed from a mixture of copper and boron rbide powders and ground to a thickness of 0.006 in. The disks ere copper plated, and bismuth and lead disks fused on to the posite faces. A hundred of these sections, separated by metal acers, were assembled to form a thermopile. The output of the ermopile and its internal resistance ($\frac{3}{4}$ mΩ) are low, and the gnal is amplified using a second-harmonic magnetic modulator llowed by a 1 kc/s tuned transistor amplifier. The system gives output of 9×10^{-11} V (r.m.s.) per neutron cm^{-2} sec^{-1}, and has a esponse time of 45 msec. R.D.Smith

539.1.07

166. A SPHERE-MOUNTED PISTOL-TYPE MANIPULATOR. .Ney.
ukleonika, Vol. 2, No. 4, 653-5 (1957). In Polish.
A description and sketch are given of a prototype manipulator ade in stainless steel for the remote handling of objects under 1 kg eight. J.Adam

ELEMENTARY PARTICLES

539.12

5167. COVARIANT EQUATION FOR TWO ANNIHILATING PARTICLES. A.I.Alekseev.
Zh. éksper. teor. Fiz., Vol. 32, No. 4, 852-62 (1957). In Russian.
English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 4, 696-704 (Nov., 1957).
The functional-derivative technique is used to investigate the annihilation (or production) of two interacting particles which may also exist in a bound state. Covariant equations were found for the Green's function (probability amplitude) which describes the annihilation of an electron and a positron into two quanta as well as for the Green functions of the reverse process. The equations thus obtained were used to solve the problem of interaction between the electron and positron during pair production (or annihilation) with account of radiative correction. A.

539.12 : 530.145

5168. NEW WAVE EQUATIONS FOR ELEMENTARY PARTICLES. Y.Murai.
Nuclear Phys., Vol. 6, No. 3, 489-503 (April [1], 1958).
The aim of this paper is to give an interpretation of the equation which was proposed by Umezawa and Visconti (Abstr. 2784/1958) for isomerization of particles of non-zero mass. The deduction of the equation is done by extending the definition of equivalent observers and introducing a new variable. The latter procedure is necessary to reconcile the extended definition of equivalent observers with the classical law of inertia, and it can be done in a unique way. A.

539.12

5169. A TENTATIVE UNIFIED CLASSIFICATION OF ELEMENTARY PARTICLES, INCLUDING LEPTONS. V.I.Goldanski.
Nuclear Phys., Vol. 6, No. 3, 531-8 (April [1], 1958).
A unified classification of all families of elementary particles, that is, of baryons, Bose mesons and light fermions (leptons: μ, e, ν) is proposed. The classification is based on extension of the isobaric multiplet principle to leptons. One of the corollaries of the scheme is that the six leptons known at present are the only ones that may exist. In weak interactions leading to the production of leptons the change of the 3-projection of the isobaric spin is ΔT_3 $\frac{1}{2}$ 0, $\pm\frac{1}{2}$. When viewed from this angle the values of the ΔT_3 in various ways of hyperon β-decay indicate that many different modes of decay are possible, excepting a few cases that are specially mentioned. The selection rules for T_3 are not sufficient to explain the absence of weak interactions involving formation of various electrically neutral lepton pairs. The absence of such interactions can be explained by introducing for leptons a certain number $N = Q - \frac{1}{2}m$ (Q = electric charge, m = neutrino charge) and postulating the selection rule $\Delta N = \pm 1$ for weak interactions involving lepton production. A.

539.12

5170. THE APPLICATION OF LEONTOVICH'S BOUNDARY CONDITIONS TO THE CHERENKOV RADIATION THEORY. A.I.Morozov.
Zh. éksper. teor. Fiz., Vol. 33, No. 4(10), 933-5 (1957). In Russian.
The field of charge moving above a flat boundary is computed using Leontovich's approximate boundary conditions. A.

539.12 : 778.34

5171. ON THE THEORY OF SCATTERING MEASUREMENTS IN NUCLEAR EMULSION. I. THE DISTRIBUTION FUNCTIONS OF THE COORDINATE DIFFERENCES. N.Solntseff.
Nuclear Phys., Vol. 4, No. 3, 337-62 (Sept., 1957).
Molière's theory of multiple scattering measurements in nuclear emulsion is here treated in a mathematically simpler way. The distribution functions of the second, third and fourth differences of coordinates arising from true scattering and noise are derived for the constant-cell method. It is shown that the relation between the mean noise ϵ_r for the r^{th} differences and the error σ_N of a coordinate measurement is $\epsilon_2 = 1.96\sigma_N$, $\epsilon_3 = 3.56\sigma_N$ and $\epsilon_4 = 6.68\sigma_N$. Therefore, to obtain a noise level of 0.15 μ for second differences the error σ_N should be less than 0.075 μ. In this case $\epsilon_3 = 0.28$ μ and $\epsilon_4 = 0.50$ μ. The effect of the finite size of the nucleus on the distribution functions of the coordinate differences is evaluated in an approximate way. A.

539.12 : 778.34

5172. ON THE THEORY OF SCATTERING MEASUREMENTS IN NUCLEAR EMULSION. II. THE ESTIMATION OF TRUE SCATTERING IN THE PRESENCE OF DISTORTION. N.Solntseff.
Nuclear Phys., Vol. 6, No. 2, 222-51 (March [3], 1958).

The effect of distortion on the scattering measurements in nuclear emulsion is here evaluated theoretically. The Molière–d'Espagnat method for estimating true scattering in the presence of experimental errors is extended to the case when third or fourth differences of the coordinates are used. The expressions for the relative standard error of the estimates of scattering from third and fourth differences are derived. The distortion is assumed to be of second order but the treatment can be easily extended to any regular type of distortion. It is found that an unbiased estimate can also be obtained for a distorted track by Fowler's method of eliminating distortion, in which the algebraic mean second difference is subtracted from each of the D_i. However, the relative standard error of such an estimate will in general be larger than the error of an estimate obtained from third and fourth differences. In the measurement of particles with pv greater than 1 GeV the bias introduced by distortion can be appreciable and third or fourth differences should be used. An imaginary estimate of noise is sometimes obtained. This will happen whenever the standard deviation of the D_i due to noise is less than $\cong \overline{D_d}$, where $\overline{D_d}$ is the mean second difference due to distortion. The estimation equations recommended for practical use are given. A.

539.12

5173. NOTE ON THE ELASTIC SCATTERING OF HIGH-ENERGY PARTICLES. L.I.Schiff.
Nuclear Phys., Vol. 4, No. 4, 632-3 (Oct., 1957).

The criticism by Khalatnikov (Abstr. 677/1958) of the derivation (Abstr. 6364/1956) of the large angle scattering formula is answered. It is shown that the sum and not the average over regions of stationary phase is required in evaluating the nth Born approximation term. G.H.Burkhardt

539.12 : 530.145

5174. DAMPING THEORY STUDY OF ELASTIC SCATTERING OF DIRAC PARTICLES WITH ACCOUNT OF POLARIZATION EFFECTS. A.A.Sokolov, B.K.Kerimov and I.I.Guseinov.
Nuclear Phys., Vol. 5, No. 2, 390-400 (Jan. [2], 1958).

Elastic scattering of Dirac particles by a short-range force centre is considered from the standpoint of radiation damping theory. The expression for the scattering amplitude is determined. The integral equation thus obtained for the scattering amplitude permits one to investigate polarization effects. A.

539.12 : 539.17

5175. THE ENERGY DEPENDENCE OF THE SCATTERING CROSS-SECTION NEAR THE REACTION THRESHOLD. A.I.Baz'.
Zh. éksper. teor. Fiz., Vol. 33, No. 4(10), 923-8 (1957). In Russian.

An investigation was made of the energy dependence of the elastic scattering cross-section X(a,a)X near the threshold of reaction X(a,b)Y (b=neutron). It is shown that the scattering cross-section has a singularity at the threshold point, and a study of this singularity permits determination of the parity and evaluation of the spin of the nucleus Y produced in the reaction, and, also, it radically simplifies the phase analysis of elastic scattering. A.

539.12 : 537.531 : 539.219

SCATTERING OF PARTICLES BY SOLID SOLUTIONS. See Abstr. 4461

539.12 : 530.145

TWO-BODY COLLISIONS. See Abstr. 4740

539.12

5176. STOPPING POWER OF A MEDIUM FOR HEAVY, CHARGED PARTICLES. M.Gryziński.
Phys. Rev., Vol. 107, No. 6, 1471-5 (Sept. 15, 1957).

It is shown that the orbital motion of electrons in the molecules of a medium is important for the stopping power of slow charged particles. This is due to the strong dependence of the momentum transfer in a Coulomb field on the relative velocity. Equations for determining the absolute stopping power of an arbitrary medium are derived on the basis of classical mechanics for the entire non-relativistic energy range. For the high-energy range this equation corresponds to Bethe's formula, and for low energies, to the Fermi–Teller formula. It is concluded, from this equation and from the experimental data, that electron capture is not important in the slowing down of protons. It starts being important for α-particles and is decisive for particles of higher charge. The stopping power of H, H_2, and A for protons and of H_2 for α-particles is calculated. Good agreement with the experimental data is obtained. A.

539.12

5177. STATISTICAL THEORY OF THE MULTIPLE FORMATION OF PARTICLES.
S.Z.Belen'kiĭ, V.M.Maksimenko, A.I.Nikishov and I.L.Rozental'.
Uspekhi fiz. Nauk, Vol. 62, No. 2, 1-36 (1957). In Russian.

A detailed review of the topic based on Fermi statistics dealing with: isotope spin, identity, distribution by charged state, phase volume, momentum distribution of secondary particles, comparison of theoretical and experimental data for N–N and π–N collisions at energies of 1-5 BeV, application of statistical theory to processes associated with annihilations of antinucleons. Three appendices deal with probabilities of charged states in statistical theory, charge distribution and isotope invariance, and deduction of a general expression for the phase volume of a system of arbitrary particles. 60 references. C.R.S.Manders

539.12 : 530.145

MULTIPLE PRODUCTION OF PARTICLES. See Abstr. 4749

539.12

5178. INVESTIGATIONS ON THE POSSIBILITY OF REPRESENTING THE PHOTON BY AN ELECTROMAGNETIC MODEL. N.S.Kalitzȳn and I.Todorov.
C.R. Acad. Bulg. Sci., Vol. 11, No. 1, 13-16 (Jan.-Feb., 1958). In German.

An earlier paper gave some singular solutions of the Maxwell equations which can be regarded as representing photons. This paper discusses whether the singularities can be replaced by charge distributions, and if so whether they are stable. P.M.Davidson

539.12

5179. A CASCADE SHOWER IN NUCLEAR EMULSIONS.
S.Tokunaga and K.Nishikawa and T.Ishii.
J. Phys. Soc. Japan, Vol. 12, No. 3, 219-21 (March, 1957).

A good example of a cascade shower in nuclear emulsions was analysed, and its energy was determined from its lateral distribution at successive stages of its development comparing with cascade theory, and was found to be 2.5×10^{11} eV. It is possible to measure the energy of high-energy γ-rays or electrons with an accuracy of a factor two. A.

539.12

5180. COULOMB CORRECTIONS TO DELBRÜCK SCATTERING.
F.Rohrlich.
Phys. Rev., Vol. 108, No. 2, 169-70 (Oct. 15, 1957).

Observation of Delbrück scattering is most feasible on heavy elements and in the 1-3 MeV region, where the Born approximation is expected to be very poor. The Coulomb corrections to the known forward scattering amplitude in Born approximation can be computed with the aid of the dispersion relations, making use of theoretical and experimental knowledge of the total cross-section for pair production. Explicit calculations are carried out for a lead target. The results show that the corrections are effectively much smaller than anticipated. In the energy region of interest the corrections to the dispersive amplitude are only a few per cent. The corrections to the absorptive amplitude are largest (a factor of two near 1.33 MeV) where this amplitude is negligible compared to the dispersive scattering amplitude. A.

539.12

5181. SCATTERING OF 25-87 MeV PHOTONS BY PROTONS.
C.L.Oxley.
Phys. Rev., Vol. 110, No. 3, 733-7 (May 1, 1958).

Scattering of 87 MeV bremsstrahlung by liquid hydrogen was measured with a lead converter-telescope arrangement at angles from 70-150°. The weighting function of the cross-section peaks at 60 MeV, has a full width of 55 MeV, and is approximately symmetrical. In this angular range contributions from processes other than elastic scattering from protons are believed to be small. The observed cross-sections are somewhat smaller and flatter in angular distribution than those given by Powell's formula for scattering by a point proton with the static anomalous moment. A.

539.12 : 530.145

5182. SYMMETRICAL STRUCTURE AND CONSERVATION RELATIONS OF FOUR-COMPONENT NEUTRINO FIELD.
T.Takabayasi.
Nuclear Phys., Vol. 6, No. 3, 477-88 (April [1], 1958).

A four-component spinor field with zero rest-mass ψ is represented as the field defined by its modulus ρ, an orthogonal frame in two-dimensional internal space, and a Lorentz frame in 4-dimensional internal space. This representation manifests the perfect

sotropic property of the field in both internal spaces. In fact, the neutrino equation is invariant under arbitrary rotations in those internal spaces, which are conversely expressible by a certain four-component spinor ζ. As the result of these new invariance properties the neutrino field is shown to satisfy several conservation relations that are vector or tensor equations with respect to both internal spaces. They contain, besides the conventional ones, a number of new conservation laws. A.

539.12 : 539.1.07

5183. MEASUREMENT OF ENERGY OF ELECTRON PAIRS GREATER THAN 1 GeV IN NUCLEAR EMULSIONS. R.Weill, M.Gailloud and P.Rosselet.
Nuovo Cimento, Vol. 6, No. 3, 413-24 (Sept., 1957). In French.

Describes a method of measuring the projected angle of opening (ω) which reduces the uncertainties due to noise introduced by multiple scattering and grain dispersion. The separation of the tracks is measured at several distances from the origin and a calculation made of $\Omega = \omega + Z$, where Z is a Gaussian variable of zero mean value given by the noise level. Energies up to 20 GeV can be determined if the criterion for acceptance of the result is that the probability for $\omega > Z$ is greater than 0.68. This is to be compared with a maximum of 1.5 GeV for the usual method. Ionization measurements on the initial tracks of electron pairs with energies > 10 GeV allow a relative value of their angles of opening to be estimated from standard curves. The values agree with those predicted by Della Corte. Measurements on 4 secondaries of a jet with an energy > 1000 GeV per nucleon showed that the effect of spurious scattering is negligible for horizontal separations and height differences $< 30\ \mu$, and cell lengths up to 2 mm. E.J.Burge

539.12

5184. DIRECT PRODUCTION OF ELECTRON PAIRS BY HIGH-ENERGY ELECTRONS. MODEL FOR THE FORMATION OF THE INITIAL TRACK OF ELECTRON PAIRS. ELIMINATION OF FALSE TRIDENTS. R.Weill, M.Gailloud and P.Rosselet.
Nuovo Cimento, Vol. 6, No. 6, 1430-44 (Dec., 1957). In French.

The mean free path for direct electron pair production by electrons in the energy regions 2 to 8 GeV, 8 to 32 GeV, 32 to 150 GeV, has been measured. The values obtained are less than those foreseen by Bhabha's theory. The disagreement cannot be ascribed to energy underestimates. A three-dimensional model of track formation in nuclear emulsion is described, which accounts for the ionization variation observed at the beginning of electron pairs of more than 10 GeV. This indicates that the energy determinations using methods described previously (preceding abstract) are correct; while energies evaluated on the basis of dipole effect theory can be overestimated by 100 times. The number of unresolvable "bremsstrahlung" pairs produced on the track of an electron of known path and energy has been calculated. Errors inherent in Koshiba and Kaplon's method (Abstr. 451/1956) are thus eliminated. A.

539.12

5185. THE ENERGY SPECTRUM OF CASCADE ELECTRONS IN LEAD. I.P.Ivanenko.
Zh. éksper. teor. Fiz., Vol. 32, No. 3, 491-7 (1957). In Russian.
English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 3, 413-18 (Oct., 1957).

Recurrence formulae were obtained for the nth moment of the distribution function of a shower containing particles with energies above a prescribed value. The first two moments of the electron distribution function in lead were calculated. The moment method was applied to compute the energy spectrum of cascade electrons in lead. A.

539.12

5186. BREMSSTRAHLING AND PAIR PRODUCTION AT HIGH ENERGIES IN CONDENSED MEDIA. A.B.Migdal.
Zh. éksper. teor. Fiz., Vol. 32, No. 4, 633-46 (1957). In Russian.
English translation in; Soviet Physics — JETP (New York), Vol. 5, No. 4, 527-36 (Nov., 1957).

The effect of multiple scattering on bremsstrahlung and pair production is considered. The probability of these processes decreases appreciably at energies $\sim 10^{13}$ eV. The computation is carried out with the aid of the density matrix. Equations are derived for the probability of pair production and bremsstrahlung per unit path for electrons and quanta of arbitrary energy. A.

539.12

5187. ELECTRON SCATTERING CROSS SECTIONS BASED ON THE THOMAS—FERMI THEORY. M.Majewski and T.Tietz.
Phys. Rev., Vol. 108, No. 2, 193-6 (Oct. 15, 1957).

All known approximations, for the Thomas—Fermi function are considered, by means of which one may calculate in the first Born approximation the scattering amplitudes for a fast electron and the total cross-section. A.

539.12

5188. THREE BETA-ABSORPTION METHODS — HOW DO THEY COMPARE? J.F.Duncan and F.G.Thomas.
Nucleonics, Vol. 15, No. 10, 82-5 (Oct., 1957).

The Feather, Bleuler—Zunti, and Harley—Hallden methods of β-range measurement in Al absorbers were used to determine E_{max} for C^{14}, Bi^{210}, Pa^{234}, and Na^{22}. Results show that the most generally useful method is that of Bleuler and Zunti. Harley and Hallden's method is quicker but of lower accuracy and Feather's method is applicable to strong sources. R.D.Smith

539.12

5189. MEASUREMENT OF POLARIZATION OF RELATIVISTIC ELECTRONS. C.Bouchiat and L.Michel.
Nuclear Phys., Vol. 5, No. 3, 416-34 (Feb., 1958). In French.

A covariant formalism for handling electron polarization is described and it is shown how to use it in quantum field theory calculations. It is applied to the study of polarization effects in electron—electron collisions. These effects can be used for the measurement of the transverse and longitudinal polarization of relativistic electrons. A.

539.12 : 539.2

5190. POSITRON ANNIHILATION IN THE NOBLE METALS. B.Donovan and N.H.March.
Phys. Rev., Vol. 110, No. 2, 582-3 (April 15, 1958).

Reports a Wigner—Seitz calculation of the positron wavefunction for $k = 0$ in Cu. The function penetrates into the core and it is concluded that the high-momentum components in the electronic momentum distributions deduced from positron-annihilation experiments are not due to an "excluded volume effect" but to core annihilation. D.M.Edwards

539.12

5191. APPLICATION OF DISPERSION RELATIONS TO NUCLEON STRUCTURE. K.Tanaka.
Phys. Rev., Vol. 110, No. 5, 1185-9 (June 1, 1958).

The dispersion relations derived by Chew et al (see Abstr. 7428, 7438/1957) are used to carry out a covariant calculation of the form factors for the charge and magnetic moment of the proton. Root-mean-square radii of 0.64×10^{-13} cm for the charge distribution and 0.45×10^{-13} cm for the magnetic moment distribution are found on the assumption that the proton has a point core and that the coupling constant is $f^2 = 0.08$. Recoil terms tend to reduce the r.m.s. radii obtained from the static model. The higher-order mesonic corrections do not alter the qualitative behaviour of the perturbation results. A.

539.12 : 530.145

5192. NUCLEON MAGNETIC MOMENT IN CUT-OFF MESON THEORY. S.K.Kundu.
Proc. Phys. Soc., Vol. 72, Pt 1, 49-52 (July, 1958).

The effect of nucleon current contribution to nucleon magnetic moment is considered up to the fourth order of the coupling constant in the cut-off meson theory using the renormalization procedure as developed by Chew. The same parameters as employed to fit the meson—nucleon scattering data were used here. It is found that the additional contribution due to this effect improves the previous theoretical results where only the mesonic current contribution has been taken into account. A.

539.12

5193. STATISTICAL THEORY OF PARTICLE MULTIPLE PRODUCTION IN HIGH ENERGY NUCLEON COLLISIONS. V.S.Barašenkov, B.M.Barbašev and E.G.Bubelev.
Nuovo Cimento Suppl., Vol. 7, No. 1, 117-28 (1958).

Tables are presented of statistical calculations of multiple particle production in (pp) and (np) collisions at 7 and 10 GeV. Since there is sharp disagreement with experiment if all the particles are assumed to be created in the same interaction volume,

calculations are made under two different assumptions with respect to the character of the elementary interactions. In (1) it is assumed that the hyperons interact with pions as strongly as nucleons, so these particles are produced in the same volume V_π (with radius equal to the pion Compton wavelength). The K-mesons are assumed to have a considerably weaker interaction with the pion field and are therefore produced in the volume V_K, characterized by the K-meson Compton wavelength, if the interaction energy of K-mesons with the baryon field, which is produced by the pion field in the volume V_π, is neglected in comparison with the direct interaction energy with the baryon field localized in V_K. This corresponds to the "global interaction" hypothesis of Schwinger and Gell-Mann. In (2) it is assumed that all strange particles, in contrast to the nucleons, interact with the pion field comparatively weakly so they are all produced in the volume V_K while the pions, nucleons, isobars — which are introduced (Abstr. 5866/1957) to take account of the resonant pion-nucleon interaction in the state $P_{3/2}$, $T = 3/2$ — and their antiparticles are produced in the volume V_π. This corresponds to the ideas of Neganov and Peaslee. P.K.Kabir

539.12

5194. POLARIZATION IN THE ELASTIC SCATTERING OF NUCLEONS ON A TARGET WITH SPIN ONE. G.M.Budyanskiĭ.
Zh. éksper. teor. Fiz., Vol. 33, No. 4(10), 889-900 (1957).
In Russian.

A determination is made of the mean values of the spin operators of a system of particles of spin 1 and 1/2. The most general expression is found and an explicit form of the transition matrix M is given. A particular case is considered of small energies at which it is possible to confine oneself to S and P waves. Equations are obtained for cross-section, polarization, and correlation functions. Relationships are established between the parameters of the transition matrix and the experimentally observed values. A set of experiments is indicated which enables one, by carrying out triple scattering, to determine the amplitude of the scattered wave and to make a phase analysis. A.

539.12 : 539.17

INELASTIC SCATTERING OF HIGH ENERGY NUCLEONS BY COMPLEX NUCLEI. See Abstr. 4326

539.12 : 539.14

5195. OPTICAL MODEL ANALYSIS OF PROTON SCATTERING ON SOME LIGHT NUCLEI. A.Hossain and Syeduzzaman.
Nuclear Physics, Vol. 4, No. 1, 88-90 (Aug., 1957).

The calculations of Burge et al.(Abstr. 3100/1956) on the scattering of 9.5 MeV protons by He^4, N^{14} and A^{40} (Abstr. 339, 1189-90/1955) are carried out with a new radius $R = (0.6 + 1.26\,A^{1/3}) \times 10^{-13}$ cm for the square well. From the great sensitivity of the angular distribution, the authors conclude that the shape of the well at the nuclear boundary (and also a spin–orbit potential) should be taken in account. J.Lascoux

539.12

5196. THE ASYMMETRY OF 155 MeV PROTONS ELASTICALLY SCATTERED FROM IRON, NICKEL AND COPPER.
R.Alphonce, A.Johansson and G.Tibell.
Nuclear Phys., Vol. 4, No. 5, 643-7 (1957).

The asymmetry of protons scattered elastically from iron, nickel, and copper was measured in the angular region 5°-26°. The conventional double-scattering technique with range telescopes was used. The angular patterns are quite similar for the three elements and resemble the curves for carbon, oxygen and calcium. A.

539.12

5197. POLARIZATION OF HIGH ENERGY PROTONS IN ELASTIC AND INELASTIC SCATTERING.
P.Hillman, A.Johansson and H.Tyrén.
Nuclear Phys., Vol. 4, No. 5, 648-61 (Nov., 1957).

The polarizations of 173-7 MeV protons inelastically and elastically scattered by carbon, oxygen, and calcium were measured with an energy resolution of 2-2.5 MeV full-width at half-height equivalent. The polarizations of scattered protons corresponding to the low-lying levels of all three elements are large and show strikingly similar angular patterns. The higher levels are much less polarized. The elastic results differ from measurements of elastic asymmetries in having deeper minima, and were extended to larger angles. A.

539.12

5198. THE SCATTERING OF 185 MeV PROTONS FROM DEUTERIUM AND NEON. H.Tyrén, G.Tibell and T.A.J.Maris.
Nuclear Phys., Vol. 7, No. 3, 281-3 (June [3], 1958).

The energy spectra of 185 MeV protons scattered off deuterium and neon were recorded with a magnetic analyser. Gaseous targets were used, and five angles in the region 10° to 28° were studied. A.

539.12

5199. AZIMUTHAL SYMMETRY IN PROTON SCATTERING AT 980 MeV. N.E.Booth, F.L.Hereford, M.Huq, G.W.Hutchinson, M.E.Law, A.M.Segar and D.H.White.
Nuclear Phys., Vol. 7, No. 3, 284-8 (June [3], 1958).

The relative intensities of protons scattered near the vertical and near the horizontal planes at the second event of a double-scattering process were studied, the first scattering having taken place in the horizontal plane. Protons of kinetic energy 980 MeV were scattered first from carbon at 4° and then from either carbon or polyethylene at 14°. They were detected by an array of scintillation counters which could be rotated about an axis along the flight path of the protons between the two scatterers, and which was arranged so as to detect preferentially the elastic proton–proton scattering in the polyethylene. The ratio of horizontal to vertical scattering was found to be 0.940 ± 0.056, in proton–proton collisions. A.

539.12

5200. ELASTIC AND QUASI-ELASTIC SCATTERING OF 660 MeV PROTONS BY DEUTERONS. G.A.Leksin.
Zh. éksper. teor. Fiz., Vol. 32, No. 3, 445-52 (1957). In Russian.
English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 3, 371-7 (Oct., 1957).

The differential elastic p–d scattering cross-sections at angles of 40° to 150° and the differential quasi-elastic p–p scattering cross-sections at angles of 50° to 90° of the two nuclei were measured in the centre-of-mass system by the ganged-telescope method. The experimental data point to the existence of a predominant interaction between the incident proton and the separate nucleons in the deuteron and also to the existence of collective interactions between the three nucleons. The energy dependence of the differential cross-section of quasi-elastic p–n scattering into an angle of 90° in the c.m.s. of the two nucleons was also measured in the 460 to 660 MeV range. A.

539.12

5201. CHARGE DEPENDENT EFFECTS ON SCATTERING LENGTHS OF np AND pp SYSTEMS. Riazuddin.
Nuclear Phys., Vol. 7, No. 3, 217-22 (June [3], 1958).

The effects of the electromagnetic structure of a nucleon on the singlet scattering lengths a_{np}, a_{pp} of n–p and p–p systems are calculated. They are found to be much too small to remove the discrepancy between a_{np} and a_{pp}. It is shown to be plausible that the discrepancy between a_{np} and a_{pp} may be due to $\pi^+ - \pi^0$ mass difference when its kinematic and dynamical effects, as defined in the text, are taken into account. A.

539.12

5202. INELASTIC PROTON–PROTON SCATTERING.
Yu.I.Kulakov.
Zh. éksper. teor. Fiz., Vol. 32, No. 3, 576-83 (1957). In Russian.
English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 3, 477-82 (Oct., 1957).

The problem of inelastic proton–proton scattering at 690 MeV is considered. It is assumed that in the intermediate state an isobar is formed which decays into a nucleon and π-meson. Limiting the consideration to isobars in S-states, using the laws of conservation of angular momentum and parity, and taking into account the Pauli principle, it was found possible to obtain the angular distribution of scattered nucleons, with the introduction of only one arbitrary constant. A.

539.12 : 539.17

INELASTIC SCATTERING OF PROTONS BY MEDIUM WEIGHT NUCLEI. See Abstr. 4313

539.12

5203. ELASTIC SCATTERING OF ANTIPROTONS BY NUCLEI.
I.E.McCarthy.
Nuclear Phys., Vol. 4, No. 3, 463-8 (Sept., 1957).

The large annihilation cross-section for antiprotons may be due either to a very strong attraction or to a very small free path in nuclear matter and a large nuclear rim of low density. In either case the nucleus must be considered black to antiprotons and the behaviour of the beam in the nuclear boundary is important. It is shown that the anomalously small diffraction cross-section observed in early experiments cannot be explained by a boundary effect if

he real potential is not very large. Emulsion experiments have shown that the differential cross-section near 2° is less than that predicted by Rutherford scattering. A similar discrepancy arises from assuming that the nucleus is a charged totally absorbing sphere. A.

539.12

5204. PHENOMENOLOGICAL NEUTRON—PROTON POTENTIALS. R.G.Newton and T.Fulton.
Phys. Rev., Vol. 107, No. 4, 1103-11 (Aug. 15, 1957).

Central, tensor, and spin—orbit potentials are calculated for the neutron—proton triplet state. They allow explicit solution of the Schrödinger equation and fit the low-energy data: effective range, scattering length, deuteron binding energy, quadrupole moment, and D-state probability. The deuteron wave-function as well as scattering wave-functions which result from these potentials are also computed. A potential and wave-functions which fit the low-energy singlet state data are also obtained. A.

539.12 : 532.7

5205. SCATTERING OF SLOW NEUTRONS BY A LIQUID. G.H.Vineyard.
Phys. Rev., Vol. 110, No. 5, 999-1010 (June 1, 1958).

The differential cross-section for coherent scattering of thermal neutrons by a liquid is given in general by the Fourier transform of a time-displaced radial density function. It is suggested that, to an adequate degree of approximation, this time-displaced function can be expressed as a convolution of the ordinary radial density function with a self-diffusion function describing the wandering of an atom from an arbitrary initial position. The neutron scattering cross-section then becomes the product of the Fourier transforms of these two functions. One of the transforms is the differential cross-section for X-ray scattering and describes interference effects, the other governs the energy changes upon scattering. In this development the scatterer can be treated either quantum mechanically or classically. Recoil effects are not provided by the classical treatment, but this is a significant deficiency only in liquids of low atomic weight. Several models for calculating the self-diffusion function are considered, and from these it is suggested that a Gaussian function with a time-dependent width is a reasonable approximation for the case of a simple liquid. The principal features of the width are deduced. Quantization of the scatterer effects the width at small times. At large times the width depends only on the coefficient of self-diffusion of the liquid, and inelastic scattering is suggested as a means of determining this coefficient, as well as other features of atomic movement. The accuracy of the static approximation for determining liquid structures by neutron diffraction is assessed by considering the typical case of liquid lead near its melting point, and is found to be moderately good. The extension of the entire formalism to the case of polyatomic liquids is outlined. A.

539.12 : 539.14

5206. EFFECT OF THE DIFFUSENESS OF THE NUCLEAR BOUNDARY ON NEUTRON SCATTERING. V.N.Gribov.
Zh. éksper. teor. Fiz., Vol. 32, No. 4, 647-52 (1957). In Russian. English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 4, 537-41 (Nov., 1957).

It is shown that the scattering amplitude for a potential with a diffuse boundary whose width is small compared with the wavelength of the incident particle can be expressed in terms of the phase-shifts for scattering by a rectangular potential of a smaller radius and three numerical parameters which determine the shape of the potential. The parameters were computed for the potential and the scattering amplitude was determined. The problem of passage through a barrier whose width is small compared with the wavelength of the incident particle is also considered. A.

539.12 : 538.114

5207. SCATTERING OF SLOW NEUTRONS IN FERROMAGNETICS. S.V.Maleev.
Zh. éksper. teor. Fiz., Vol. 33, No. 4(10), 1010-21 (1957). In Russian.

Scattering of slow neutrons in ferromagnetics is considered at low temperatures using the theory of spin waves. This scattering is considered for single and polycrystals. A.

539.12

5208. TEMPERATURE DEPENDENCE OF THE DIFFUSION COEFFICIENT AND THE DIFFUSION LENGTH OF THERMAL NEUTRONS IN WATER. W.H.Dio and E.Schopper.
Nuclear Phys., Vol. 6, No. 2, 175-6 (March [3], 1958).

The diffusion coefficient and mean lifetime were measured, using a pulsed neutron source, at water temperatures of 19° C, 49° C and 75° C. From the measurements the corresponding diffusion lengths were calculated. The results can be expressed:

$$D = 35050 + (T - 19)(130 \pm 30)\ \text{cm}^2/\text{sec}, \text{ and}$$
$$L = 2.70 + (T - 19)(0.0054 \pm 0.0022)\ \text{cm}.$$

These results are not significantly different from previous results obtained in the temperature range 10° C to 35° C. The gradient of the expression for the diffusion coefficient is in good agreement with an assumption of a 1/v dependence of the transport cross-section. A.J.Salmon

539.12 : 530.162

NEUTRON DIFFUSION: TRANSFER PROBLEMS AND RECIPROCITY PRINCIPLE. See Abstr. 4768

539.12

5209. HOW CHANNELING BETWEEN CHUNKS RAISES NEUTRON TRANSMISSION THROUGH BORAL. W.R.Burrus.
Nucleonics, Vol. 16, No. 1, 91-4 (Jan., 1958).

Boral (a mixture of boron carbide and aluminium, clad in thin aluminium) is used as a shield for thermal neutrons. The transmission T was calculated using the expression $T = [1 - VF]^{t/l}$ where V = volume fraction of slab occupied by B_4C particles, F = average absorption of single particle, t = thickness of slab and l = average chord length of a particle. The results are more nearly in agreement with experiment than earlier calculations neglecting channelling which overestimated absorption in $\frac{1}{4}$ in. boral by more than a factor of 10. R.D.Smith

539.12

5210. AN EMPIRICAL FORMULA FOR THE MASSES OF THE ELEMENTARY PARTICLES. L.S.Levitt.
Curr. Sci., Vol. 27, No. 4, 131 (April, 1958).

It is noted that the masses of the mesons, and the differences of masses of the baryons are integral multiples of $m_e/2\alpha$ to within 10%, where m_e is the electron mass and $\alpha = 1/137$, the fine structure constant. No suggestion is given either for the unit or the choice of integers. G.H.Burkhardt

539.12 : 530.145

5211. ON THE QUESTION OF POSSIBLE CHARGE PROPERTIES OF WEAK INTERACTIONS. R.Gatto and R.D.Tripp.
Nuovo Cimento, Vol. 6, No. 2, 367-70 (Aug., 1957).

Constraints imposed by the $\Delta T = \frac{1}{2}$ rule, time reversal invariance and parity conservation on (a) the Σ lifetime ratio and Σ^+, Λ^0 branching ratios, and (b) the K^+/K^0 lifetime ratio and K^+ branching ratios, are considered in relation to the experimental data available. R.H.W.Johnston

539.12 : 530.145

5212. PARITY MIXTURES AND DECAY PROCESSES. H.S.Green and C.A.Hurst.
Nuclear Phys., Vol. 4, No. 4, 589-98 (Oct., 1957).

This paper examines the hypothesis that the μ-meson as well as the Λ and Σ-hyperons are parity mixtures, and shows that the facts commonly attributed to parity non-conservation are explained in a unified way by this hypothesis, provided physical theory is invariant with respect to parity conjugation. A simple theory of parity mixtures is developed in both parity conserving and parity destroying forms, to distinguish those experimental consequences which are incompatible with parity conservation. It is pointed out that the experiments on $\pi - \mu - e$ decay do not establish a failure of parity conservation as claimed, and that there is at present no evidence which conclusively verifies the longitudinal neutrino hypothesis. The latter, however, may be regarded as an instance of a more general hypothesis that states of "left-handed" parity do not occur in nature, in favour of which prima facie evidence already exists. The facts concerning the decay modes of the heavy mesons can also be explained readily on this basis. A.

539.12

5213. ELECTROMAGNETIC INTERACTIONS OF μ-MESONS AT GREAT DEPTHS. L.Avan.
Ann. Phys. (Paris), Sér. 13, Vol. 3, No. 1-2, 123-74 (Jan.-Feb., 1958). In French.

The electromagnetic interactions of μ-mesons (knock-on electrons, bremsstrahlung, and direct electron pair-production) are discussed, and the theoretical results are compared with experiments performed with nuclear emulsions exposed at various depths underground. S.J.Goldsack

539.12

5214. ASYMPTOTIC MESON–MESON SCATTERING THEORY.
I.T.Dyatlov, V.V.Sudakov and K.A.Ter-Martirosyan.
Zh. éksper. teor. Fiz., Vol. 32, No. 4, 767-80 (1957). In Russian. English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 4, 631-42 (Nov., 1957).

An asymptotic expression for the scattering amplitude for meson–meson interaction was obtained from a theory of the Landau, Abrikosov, and Khalatnikov type by summation of an infinite number of graphs of a certain class. The problem reduces to an integral equation of a simple type, which can be solved exactly. A.

539.12

5215. MESON SHOWERS BY HEAVY PRIMARY PARTICLES.
S.Tokunaga.
J. Phys. Soc. Japan, Vol. 12, No. 5, 454-9 (May, 1957).

Meson showers by heavy primary particles which have energy of 500 BeV per nucleon were studied with nuclear emulsions. Dealing with the event "nuclear disintegration cascade by heavy primary particle", it was possible to estimate the energy of the primary particle with much accuracy by two methods, one, by median angle of the shower particles and the other by the opening angle of the fragmentation products of the heavy primary particle. The angular distribution of the shower particles was studied and compared with the theory of Fermi and that of Landau. A.

539.12

5216. POLARIZATION OF ELECTRONS FROM μ–e DECAY.
H.Überall.
Nuovo Cimento, Vol. 6, No. 2, 376-7 (Aug., 1957).

This is derived as a function of the coupling constants on the basis of the two-component neutrino theory. It is pointed out that polarized electrons passing through matter will emit circularly polarized bremsstrahlung which is in principle accessible to experiment. R.H.W.Johnston

539.12

5217. TIME REVERSAL AND THE DECAY OF THE μ-MESON.
D.J.Candlin.
Nuovo Cimento, Vol. 6, No. 2, 390-1 (Aug., 1957).

It is pointed out that a relationship between the coupling constants which follows from time reversal invariance is capable of experimental verification by a study of the form of the μ–e spectrum below 2 MeV. Further, the longitudinal spin component of the secondary electron has been obtained as a function of the coupling constants, making possible an additional check by measurement of the electron polarization at low energy.
R.H.W.Johnston

539.12

5218. INNER BREMSSTRAHLUNG IN MU-MESON DECAY.
N.Tzoar and A.Klein.
Nuovo Cimento, Vol. 8, No. 3, 482-4 (May 1, 1958).

The transition probability for decay of the μ-meson with the emission of an additional photon is computed on the basis of the most general two-component theory of the neutrino with lepton conservation. The estimated ratio of one radiative event per 10^5 decays suggests that the experiment may be feasible in the near future. A.

539.12 : 530.145

5219. POLARIZATION OF ELECTRONS IN MUON DECAY WITH GENERAL PARITY-NONCONSERVING INTERACTIONS.
T.Kinoshita and A.Sirlin.
Phys. Rev., Vol. 108, No. 3, 844-50 (Nov. 1, 1957).

The polarization of electrons in muon decay is studied in the case of the four-component neutrino theory with general parity-nonconserving interactions. The spectrum for each of the two states of longitudinal polarization is described by a set of three parameters of which only two are independent. By observing the electron polarization in arbitrary directions, one can determine ten parameters of which six are related to the two longitudinal polarizations and the rest to the transverse part. It is seen that the prediction of the two-component neutrino theory about the electron polarization in muon decay is quite specific and can be distinguished from that of the general case, if the latter involves the interactions of the S, T, P types in charge-retention order. However, from the study of the polarization of electrons, it is impossible to distinguish the two-component theory from the four-component theory which involves only the vector-type interactions. It is noticed that the TCP theorem determines a detailed correspondence between the polarization dependence of the spectra for the μ^+ and μ^- decays. This provides us with an opportunity to determine experimentally whether weak interactions actually obey the TCP theorem or not. A.

539.12 : 530.145

5220. ON THE POLARIZATION OF ELECTRONS IN μ-MESON DECAY. B.Jakšić and J.Šoln.
Nuovo Cimento, Vol. 8, No. 3, 497-500 (May 1, 1958).

The electron polarization is calculated for the most general type of interaction Lagrangian. The results agree with Kinoshita and Sirlin's (see preceding abstract). P.Roman

539.12 : 539.165.2 : 530.145

CONSERVATION LAWS FOR β-DECAY. See Abstr. 4714

539.12

5221. STATISTICS OF PI MESONS.
B.S.Thomas and W.G.Holladay.
Phys. Rev., Vol. 110, No. 4, 981-9 (May 15, 1958).

By analysing the decay of the τ^+ meson, evidence for the boson character of π^+ mesons is obtained which is independent of the Pauli relation between spin and statistics. The usual Dalitz–Fabri expansion in angular momentum eigenfunctions is made, with the important difference that only antisymmetric states are allowed for the two like pions. The matrix elements and π^- distributions are calculated and the latter are compared with the data from 481 τ^+ decay events by using χ^2 to test the statistical significance of each hypothesis about the spin and parity of the final state. If parity is conserved in the decay, then no reasonable fit can be obtained for any spin less than 4. If parity is not conserved, then no reasonable fit can be obtained for any spin less than 3. Thus, if the τ spin is less than 3, it is concluded that π^+ mesons obey Bose statistics. This result is independent of any assumption about invariance under time reversal. A.

539.12

5222. NOTE ON THE GAMMA DECAY OF NEUTRAL PIONS.
J.Tiomno.
Nuovo Cimento, Vol. 6, No. 1, 255-7 (July, 1957).

The author's theory of strong interactions (symmetric in all mesons and all baryons) is applied to the problem of the π^0 lifetime for two-photon disintegration. Good agreement with experiment is found, but it is not possible to distinguish between it and a similar theory due to Gell-Mann and (independently) Schwinger by this means alone. Pion–proton scattering information is required in order to determine the sign of the hyperon terms, which constitutes the difference between the theories. R.H.W.Johnston

539.12 : 530.145

5223. DECAY OF THE π MESON AND A UNIVERSAL FERMI INTERACTION. K.Huang and F.E.Low.
Phys. Rev., Vol. 109, No. 4, 1400-2 (Feb. 15, 1958).

Assuming that $\pi-\mu$ and $\pi-e$ decays take place by the same mechanism, i.e. by the weak Fermi interaction of the virtual nucleus into which the π-meson dissociates, it is known (Abstr. 3264/1956) that the Fermi interaction must include pseudoscalar (P) and/or axial vector (A) terms. If it is further assumed that the Fermi interaction is the same for electron and μ-meson, the theory predicts, in general, a relative frequency for $\pi-e$ decay too high in comparison with the experimental limit of 10^{-5} (Abstr. 1186/1958). However, a mixture of interactions with $C_P/C_A \sim 10^{-3}$ suppresses the $\pi-e$ mode completely, although no explanation can be offered for the appearance of such a small number in the theory. Making this assignment, any choice of the other coupling constants, provided none of them is greater than C_A, yields a radiative $\pi-e$ decay rate well within the experimental limit. Therefore, the experimental information on radiative and non-radiative $\pi-e$ decay is compatible with the V–A interaction proposed for nuclear β-decay, (since the extra small admixture of P-interaction would be extremely difficult to detect in β-decay experiments). It is pointed out that an accurate measurement of the γ-spectrum from radiative $\pi-\mu$ decay would furnish information about the actual decay mechanism. P.K.Kabir

539.12

5224. DECAY OF THE PI MESON.
M.L.Goldberger and S.B.Treiman.
Phys. Rev., Vol. 110, No. 5, 1178-84 (June 1, 1958).

A quantitative study of $\pi \rightarrow \mu + \nu$ decay is presented using the techniques of dispersion theory. The discussion is based on a model in which the decay occurs through pion disintegration into a nucleon–antinucleon pair, the latter annihilating via a Fermi interaction to produce the leptons. The weak vertex contains effectively

both axial vector and pseudoscalar couplings even if one adopts the point of view of a universal axial vector and vector Fermi interaction. The pion—nucleon vertex which enters this model is also calculated using dispersion techniques. Under the assumption that this vertex is damped for large momentum transfers, a result is obtained for the pion lifetime largely independent of the detailed properties of the vertex and one which is in very close agreement with experiment. The precise prediction of this theory depends on the energy dependence of the complex phase shift for nucleon—antinucleon scattering in the $^1S_0$ isotopic triplet state. A.

539.12

5225. INVESTIGATION OF THE ENERGY AND ANGLE DISTRIBUTION OF NEUTRAL PIONS PRODUCED BY 470 AND 600 MeV PROTONS IN CARBON.
Yu.D.Bayukov, M.S.Kozodaev and A.A.Tyapkin.
Zh. éksper teor. Fiz., Vol. 32, No. 4, 667-77 (1957). In Russian.
English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 4, 552-9 (Nov., 1957).

Results of measurements of the energy spectra of γ-rays from the decay of neutral pions produced by 660 MeV protons in carbon are reported. The angle and energy distributions of the neutral pions are obtained by an analysis of these γ-ray spectra, and of the γ-ray spectra from pions produced by 470 MeV protons. A.

539.12

5226. PION SCATTERING AND DISPERSION RELATIONS.
J.Hamilton.
Phys. Rev., Vol. 110, No. 5, 1134-9 (June 1, 1958).

Inaccuracies in the experimental data which might give rise to the discrepancy in the dispersion relations for the forward scattering of negative pions (up to a few hundred MeV) are examined. The discrepancy cannot be removed without contradicting one of the several apparently accurate experimental results. A relation to check charge independence is suggested. A.

539.12

5227. π^-—p SCATTERING AND THE DISPERSION RELATION.
Hong-Yee Chiu.
Phys. Rev., Vol. 110, No. 5, 1140-2 (June 1, 1958).

Theoretical values for $D_-(\omega)$ in the theory of pion dispersion relations are recalculated with a suitable modification of the experimental values for σ_{tot^-}. This modification is supported by the results obtained from a recent phase-shift analysis. Agreement with the experimental values for $D_-(\omega)$ is achieved for pion kinetic energies $\lesssim 220$ MeV. It may be concluded that the theoretical values for $D_-(\omega)$ have a strong dependence on the detailed shape of the peak of σ_{tot^-} near the resonance. A.

539.12

5228. APPLICATION OF THE SPIN—FLIP DISPERSION RELATIONS TO THE MINAMI AMBIGUITY FOR THE PION—NUCLEON SCATTERING. S.J.Lindenbaum and R.M.Sternheimer.
Phys. Rev., Vol. 110, No. 5, 1174-8 (June 1, 1958).

The dispersion relations for the spin—flip amplitude of the pion—nucleon scattering in the forward direction are applied to the Minami phase shifts obtained from the Fermi set, in a calculation similar to that of Davidon and Goldberger (Abstr. 2699/1957) for the Fermi and Yang phase shifts. The Minami phase shifts were found to be in disagreement with the requirements of the dispersion relations. The same calculation was also carried out for a new set of phase shifts, which is obtained by applying the Minami transformation to the Yang phase shifts. These phase shifts are also compatible with the dispersion relations. A.

539.12

5229. ELASTIC SCATTERING OF 360 MeV POSITIVE π-MESONS BY PROTONS. N.A.Mitin and E.L.Grigor'ev.
Zh. éksper. teor. Fiz., Vol. 32, No. 3, 440-4 (1957). In Russian.
English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 3, 378-81 (Oct., 1957).

Photographic plates were used to study the angular distribution of 360 ± 10 MeV π^+-mesons elastically scattered by protons. The differential cross-section was derived from 218 scattering events by SP analysis and by SPD analysis. The phase-shifts corresponding to these distributions are given. A.

539.12 : 539.14 : 530.145

NUCLEAR FORCES AND THE SCATTERING OF π-MESONS.
See Abstr. 4753

539.12

5230. MULTIPLE PRODUCTION OF PIONS IN NUCLEAR COLLISIONS. P.P.Srivastava and G.Sudarshan.
Phys. Rev., Vol. 110, No. 3, 765-6 (May 1, 1958).

The statistical theory of meson production in nuclear collisions is given a fully covariant formulation. A single parameter of the dimensions of a mass appears in the theory, which is normalized by matching a single experimental number. Numerical results for various processes are presented. A simple recurrence relation between the covariant phase-space integrals greatly facilitates the computations. A.

539.12

5231. FORM FACTOR OF THE PHOTOPION MATRIX ELEMENT AT RESONANCE. W.K.H.Panofsky and E.A.Allton..
Phys. Rev., Vol. 110, No. 5, 1155-65 (June 1, 1958).

The inelastic scattering of electrons in hydrogen leading to pion formation was examined. Measurements were carried out in which a hydrogen target was bombarded by electrons of energy E_1 with secondary electrons of energy E_2 being detected by a magnetic analyser at a fixed angle of 75°. The energies E_1 and E_2 were programmed together such that the pions were produced at a constant energy near the peak of the pion—nucleon resonance in the $(\frac{3}{2}, \frac{3}{2})$ state; at the same time the momentum transfer to the pion—nucleon system was varied. Special procedures were developed to eliminate contributions from competing processes. Approximately three fourths of the observed cross-section corresponds to magnetic-dipole absorption of the incident virtual photon; the momentum transfer dependence can be interpreted in terms of a form factor of the difference between the magnetic moments of the neutron and proton. If the electron-scattering radii are assumed for the proton, then the data appear to require an r.m.s. radius of the magnetic moment of the neutron of about 1.1×10^{-13} cm, based on an exponential model; nucleon recoil corrections are still somewhat uncertain. A.

539.12 : 530.162

5232. THE APPLICATION OF MICROCANONICAL DISTRIBUTION TO THE STATISTICAL THEORY OF MULTIPLE PRODUCTION OF PARTICLES. V.B.Magalinskiĭ and Ya.P.Terletskiĭ.
Zh. éksper. teor Fiz., Vol. 32, No. 3, 584-91 (1957). In Russian.
English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 3, 483-8 (Oct., 1957).

The general statistical method of the microcanonical distribution is applied to the problem of the computation of statistical weights for the reactions of production of π-mesons in collisions of nucleons with nucleons. A general formula is derived for computation of the statistical weight of a state with an arbitrary set of particles, considering not only the laws of conservation of energy and momentum, but also the different type of statistics for fermions and bosons. In allowing all particles to obey Boltzmann statistics, this general formula reduces to the formula proposed by Lepore and Stuart (Abstr. 8617/1954). In particular, corrections are found which are due to consideration of the type of statistics for all possible collision processes of nucleons with nucleons, in which not more than three mesons are created. A.

539.12

5233. PRODUCTION OF NEUTRAL PIONS BY NEUTRONS ON DEUTERONS AND COMPLEX NUCLEI.
V.P.Dzhelepov, K.O.Oganesyan and V.B.Flyagin.
Zh. éksper. teor. Fiz., Vol. 32, No. 4, 678-81 (1957). In Russian.
English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 4, 560-3 (Nov., 1957).

The γ-ray yield from the decay of neutral pions produced by 590 MeV neutrons in deuterium was measured at an angle of 90° in the laboratory system. The total cross-sections for the production of neutral pions in (n,d) and (n,n) collisions, determined on the basis of these measurements, were found to be $\sigma_{nd} = (7.4 \pm 2.0) \times 10^{-27}$ cm², $\sigma_{nn} = (1.7 \pm 0.5) \times 10^{-27}$ cm². The relative yield of γ-rays from the decay of neutral pions produced in various elements was also measured at this angle. The γ-ray yield can be described approximately by the function $A^{2/3}$. A.

539.12 : 537.591.8

5234. GENERATION OF SLOW π-MESONS BY COSMIC RAY PARTICLES. D.K.Kaipov and Zh.S.Takibaev.
Zh. éksper. teor. Fiz., Vol. 32, No. 4, 690-6 (1957). In Russian.
English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 4, 569-75 (Nov., 1957).

Results of experiments on the transition effect of π-mesons are presented and discussed. The results presented allow one to conclude that low-energy mesons are abundant in the spectrum of the

generated mesons and that the plural mechanism of meson creation is correct. Most of the generating particles are probably cosmic-ray neutrons. A.

539.12 : 539.17

5235. π^0-MESON PRODUCTION IN p–p AND p–n COLLISIONS IN THE 390-660 MeV ENERGY REGION.
Yu.D.Prokoshkin and A.A.Tyapkin.
Zh. éksper. teor. Fiz., Vol. 32, No. 4, 750-66 (1957). In Russian. English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 4, 618-31 (Nov., 1957).

The total cross-sections and angular distributions for the reactions of π^0-production in p–p and p–n collisions were measured at various energies. The total cross-sections at 660 MeV were found to be $\sigma_{pp} = (3.6 \pm 0.2) \times 10^{-27}$ cm^2 and $\sigma_{pn} = (7.0 \pm 1.1) \times 10^{-27}$ cm^2. In the energy range 390-660 MeV, the total cross-section for the $p + p \rightarrow \pi^0 + p + p$ reaction is proportional to the power 5.5 of the maximum π^0-meson momentum. The π^0-meson angular distribution, which is appreciably anisotropic at the proton energy 450 MeV, becomes isotropic as the energy is increased to 660 MeV. A.

539.12

5236. INFORMATION ON THE NATURE OF HEAVY MESONS FROM PHOTOPRODUCTION EXPERIMENTS.
D.Amati and B.Vitale.
Nuovo Cimento, Vol. 6, No. 2, 395-7 (Aug., 1957).

It is pointed out that the parity of the K-meson relative to the hyperons is capable of being determined in a clear-cut way by making use of the photonuclear reactions, in particular $\gamma + p \rightarrow K^0 + \Sigma^+$, where the K^0 cannot be produced by photoelectric or catastrophic transitions but only by "shaking off". It is consequently in an S state if scalar and in a P state if pseudoscalar. The momentum dependence of the cross-section near threshold and the angular distribution of the produced K^0 would then determine the K parity. The data may also be used to determine the relative weights of the $T = \frac{1}{2}$ and $T = \frac{3}{2}$ K – Σ eigenstates.
R.H.W.Johnston

539.12 : 530.145

THE τ–θ PROBLEM. See Abstr. 4717

539.12

5237. A SEARCH FOR THE EXISTENCE OF ASYMMETRIES IN POSITIVE K-MESON DECAY. A.Wataghin, G.Alexander and R.H.W.Johnston.
Nuovo Cimento, Vol. 7, No. 1, 128-31 (Jan. 1, 1958).

Secondaries of 2697 K_θ decays were studied, including 195 resolved $K_{\mu 3}$ and 77 resolved $K_{\pi 3}$. It is found possible to exclude a 15% anisotropy of the $K_{\mu 3}$ mode with 1% confidence.
R.H.W.Johnston

539.12

5238. SOME REMARKS ON K-MESON DECAYS.
S.Oneda and S.Kamefuchi.
Nuclear Phys., Vol. 5, No. 2, 301-18 (Jan. [2], 1958).

The standpoint that the $K \rightarrow \mu(e) + \nu$ and the $K^0 \rightarrow \pi + \pi$ interactions are the primary weak interactions responsible for all K-meson decays is investigated in detail. The significance of this standpoint is discussed in connection with the true elementarity of the so called elementary particles. It is shown that this model necessarily requires the existence of two spin-zero K-mesons which are degenerate in parity. The direct experimental tests of the primarity of $K \rightarrow \mu(e) + \nu$ interactions in the $K_{\mu 3}$ and K_{e3} decays are mentioned. The evaluation of the branching ratios of K-meson decays in this model and the estimate of the magnitude of the strength of the KKπ-interaction are made. The comparison with the standpoint that the weak Fermi interaction is primary is discussed and it is inferred that the latter is more promising. A.

539.12

5239. ON THE POLARIZATION OF μ-MESONS IN $K_{\mu 3}$-DECAYS.
L.Okun.
Nuclear Phys., Vol. 5, No. 3, 455-63 (Feb., 1958).

A calculation of the longitudinal polarization of μ-mesons in $K_{\mu 3}$-decays (and of electrons in K_{e3}-decays) is carried out under the assumption that the neutrino emitted in these processes is longitudinally polarized. A.

539.12

5240. SCATTERING OF K^+ MESONS BY NUCLEONS. S.Barshay.
Phys. Rev., Vol. 110, No. 3, 743-7 (May 1, 1958).

A calculation of the scattering of low-energy ($\sim < 50$ MeV) K^+ mesons by nucleons via the mechanism of a boson–boson interaction between two pions and two K-mesons is presented. The following experimentally observed features of the low-energy scattering seem to be simply represented by the scheme: (a) the scattering is predominantly in the S wave and the cross-section shows a slight rise with increasing energy, (b) the effective nuclear potential is repulsive and of relatively short range ($\sim 1/2\mu$), (c) the charge exchange scattering is very small at very low energies. A preliminary discussion of the scattering at higher energies is given by introducing, in addition, the "direct" scattering via the interactions of K-mesons with nucleons and hyperons. A.

539.12

5241. PRODUCTION OF K MESONS AND HYPERONS IN HYDROGEN BY 1.95 BeV PROTONS. R.Lea, E.C.Fowler and H.L.Kraybill.
Phys. Rev., Vol. 110, No. 3, 748-50 (May 1, 1958).

A search was made for K-mesons and hyperons produced by a well-collimated beam of 1.95 BeV protons in a hydrogen-filled diffusion chamber. One case of associated production was observed, which is interpreted as $p + p \rightarrow \Lambda^0 + K^+ + p$. In a total track length of 2.4×10^5 g/cm^2 of hydrogen, no other hyperons or K mesons were observed to be produced. It is concluded that the cross-section for production of K mesons and hyperons is probably less than 0.4 mb. A

539.12

5242. ROLE OF PION–PION INTERACTION IN τ-DECAY.
A.N.Mitra.
Nuclear Phys., Vol. 6, No. 3, 404-19 (April [1], 1958).

The effect of the pion–pion interaction on the anisotropy of the decay pions in τ-decay and on the τ'/τ-branching ratio was studied, following the formalism of a recent paper by Dalitz. The π–π interaction is assumed to be of the resonant Breit Wigner type in the isobaric spin states $I = 0$ and $I = 2$. It is found that the assumption of an $I = 2$ resonance can satisfactorily explain the experimental figures for the momentum distribution of the unlike pion as well as the τ'/τ-branching ratio. This result serves as a supporting evidence for a recent deduction by the author of an $I = 2$ resonance within the framework of the pseudoscalar meson theory. A.

539.12 : 530.145

5243. POSSIBLE EXPERIMENTS ON THE BEHAVIOUR OF THE WEAK HYPERON DECAY INTERACTIONS UNDER P, C, AND T. R.Gatto.
Nuclear Phys., Vol. 5, No. 1, 183-6 (Jan., 1958).

Various experimental possibilities for detecting the transformation properties of the weak hyperon decay interactions under P, C, and T are discussed. A.

539.12

5244. GENERAL PARTIAL WAVE ANALYSIS OF THE DECAY OF A HYPERON OF SPIN 1/2. T.D.Lee and C.N.Yang.
Phys. Rev., Vol. 108, No. 6, 1645-7 (Dec. 15, 1957).

The general problem is considered of the decay of a hyperon of spin $\frac{1}{2}$ into a pion and a nucleon under the general assumption of possible violations of parity conservation, charge-conjugation invariance, and time-reversal invariance. Non-relativistic approximations are not made on either of the decay products. S.F.Edwards

539.12

5245. COMPARISON OF Σ^+p AND Σ^-n SYSTEMS. G.A.Snow.
Phys. Rev., Vol. 110, No. 5, 1192-7 (June 1, 1958).

Assuming that the nuclear interactions between Σ^-n and Σ^+p are charge-symmetric, the effect of the Coulomb potential in the Σ^+p system on the binding energy and wave-function of a possible bound state of the Σ^+p system is calculated. Using a phenomenological square-well potential the binding energies, ϵ_+ and ϵ_-, of the Σ^+p and Σ^-n systems are determined. In particular, it is found that the limiting condition, $\epsilon_+ \rightarrow 0$, implies that $\bar{\epsilon}_-$ is 0.38, 0.47, 0.62 MeV when the square-well range parameter, b, equals 1.4×10^{-13}, 1.0×10^{-13}, 0.6×10^{-13} cm respectively. If the Σ^-n interaction determines ϵ_- to lie in the small but finite region $0 < \epsilon_- < \bar{\epsilon}_-$, then the Σ^-n system is bound and the Σ^+p system unbound. Conversely, if Σ^+p is bound, then $\epsilon_- > \bar{\epsilon}_-$. A brief discussion of the experimental situation with regard to these hyperon compounds is given. A.

539.12

5246. NEUTRAL V-PARTICLE FROM COPPER AND CARBON.
W.A.Cooper, H.Filthuth, L. Montanet, J.A.Newth, G.Petrucci, R.A.Salmeron and A.Zichichi.
Nuovo Cimento, Vol. 8, No. 3, 471-81 (May 1, 1958).

The results of a cosmic-ray experiment on the production of

neutral V-particles in copper and carbon are given. The conclusions are based on the analysis of 51 V^0-events from copper and 28 from carbon. The ratio of number of Λ^0-particles to number of short-lived θ^0-particles at production is found to be ~ 1 : 1 in copper and ~ 1 : 2 in carbon before allowance is made for the decay modes involving only neutral particles. The momentum spectra found for V^0-particles agree with earlier results. A possible asymmetry in the decay of Λ^0-particles is discussed and estimates of the mean lifetimes of Λ^0 and θ^0-particles are given. A.

539.12

5247. ESTIMATE OF Λ—NUCLEON POTENTIAL WITH HARD CORE FROM THE BINDING ENERGY OF HYPERTRITON.
D.B.Lichtenberg.
Nuovo Cimento, Vol. 8, No. 3, 463-70 (May 1, 1958).

A variational calculation of the binding energy of hypertriton is made in order to determine the strength of a Λ—nucleon potential with an infinite repulsive core. A hard core potential is also used to describe the proton—neutron interaction. A Λ—nucleon potential is found which is stronger than the Λ—nucleon potential determined from previous calculations which assumed monotonically varying potentials. Nevertheless, the Λ—nucleon potential still does not appear to be strong enough to bind the hyperdeuteron. Tensor forces are omitted in the calculation, but an argument is given to show that their omission should not substantially affect the results. A.

539.12

5248. DECAY OF HYPER-^{5}He. R.D.Hill.
Nuovo Cimento, Vol. 8, No. 3, 459-62 (May 1, 1958).

Energy and angular distributions of the particles arising from a number of cases of the decay of $_\Lambda He^5$ are analysed. The influence of the strong spin—orbit coupled He^4—H^1 state on the decay of $_\Lambda He^5$ is noted. A.

539.12

5249. ON THE RADIUS OF THE ALPHA-PARTICLE.
I.I.Levintov.
Nuclear Phys., Vol. 4, No. 3, 330-6 (Sept., 1957).

The parameters of the alpha-particle potential are estimated from data relating to the polarization and cross-section for scattering of 315 MeV protons on He^4. Comparison with low-energy data indicates that the p—He^4 interaction range decreases by 30% when E_p increases from ≈ 10 MeV to ≈ 300 MeV. A.

539.12 : 537.531

EXCITATION OF THE X-RAY K-RADIATION BY MEANS OF Po^{210} α-PARTICLES. See Abstr. 5037

NUCLEUS

539.14

5250. SPIN—ORBIT COUPLING AND TENSOR FORCES.
B.Jancovici.
Nuovo Cimento, Vol. 7, No. 3, 290-307 (Feb. 1, 1958).

An investigation is made of the possibility of accounting for the spin—orbit potential (required for the shell-model) by a second-order effect of the two-body tensor forces. The second Born approximation is calculated for the scattering of two nucleons in nuclear matter. The average spin—orbit potential thus obtained is too small in order of magnitude, if one keeps a reasonable range for the tensor forces. The author concludes that this rather negative result is in line with the introduction of an intrinsic spin—orbit force in the two-body interaction (Abstr. 7172/1957). J.Lascoux

539.14

5251. THE TWO-BODY SPIN—ORBIT INTERACTION.
S.M.Vaidya.
Nuclear Phys., Vol. 5, No. 1, 179-82 (Jan., 1958).

The effect of the inclusion of a two-body spin—orbit interaction is considered for the deuteron. It is found that the change in the strengths of the central and the tensor interactions is significant and varies linearly with the strength of the spin—orbit interaction. A.

539.14

5252. THE RANGE OF NUCLEAR FORCES.
P.Gombás, P.Szépfalusy and E.Mágori.
Nuclear Phys., Vol. 4, No. 3, 488-90 (Sept., 1957). In German.

Assuming scalar Yukawa interaction between the nucleons, the authors determine the value of the range of the nuclear force which gives the best fit for the energies, the atomic numbers of the most stable isobars and the nuclear radii, as derived from the statistical nuclear model. A.

539.14 : 539.12 : 530.145

NUCLEAR FORCES AND THE SCATTERING OF π-MESONS. See Abstr. 4753

539.14

5253. REPULSIVE CORE AND NUCLEAR SHELL THEORY.
M.Bauer and M.Moshinsky.
Nuclear Phys., Vol. 4, No. 4, 615-24 (Oct., 1957).

The effect on nuclear shell theory of an interaction potential between nucleons containing a repulsive core is discussed. It is shown that a repulsive hard core gives rise to the same interaction energy as a delta-function potential of strength $4\pi(\hbar^2 a/m)$, where a is the range of the core and m the mass of the nucleon. The interaction energies for Yukawa potentials with and without repulsive cores, are compared. A.

539.14

5254. PHENOMENOLOGICAL NEUTRON—PROTON POTENTIALS. L.C.Biedenharn, J.M.Blatt and M.H.Kalos.
Nuclear Phys., Vol. 6, No. 3, 359-403 (April [1], 1958).

This paper presents in tabular form, and discusses some of the features of a number of phenomenological neutron—proton potentials all of which fit the low-energy neutron—proton data in the triplet spin state. Special attention has been paid to the influence of different well shapes for the central and tensor forces, and to the effect of an infinite repulsive core. The present work is the first step in an investigation of the phenomenology of nuclear forces. A.

539.14

5255. CENTER-OF-GRAVITY THEOREM IN NUCLEAR SPECTROSCOPY. R.D.Lawson and J.L.Uretsky.
Phys. Rev., Vol. 108, No. 5, 1300-4 (Dec. 1, 1957).

The j—j coupling shell model implies the existence of certain geometrical relations among the spectra of neighbouring nuclei. One such relationship is considered between states of a nucleus that is one proton or neutron away from a closed shell with states of the corresponding closed-shell nucleus. Use of this relationship has enabled excited-state spins for several nuclei to be predicted, most of which are in the vicinity of mass number 60. In two cases the existence of states that have not been observed are predicted. A.

539.14 : 539.12

5256. THE OPTICAL MODEL AT LOW ENERGIES AND DISPERSION THEORY. G.E.Brown and C.T.De Dominicis.
Proc. Phys. Soc., Vol. 72, Pt 1, 70-80 (July, 1958).

Neutron scattering in the low-energy region where the compound levels are well separated is considered in detail. It is shown that the average phase can be reproduced by that calculated from a complex potential. The imaginary part of this potential is simply related to the absorption out of the incident beam into compound states. Formulae for the average behaviour of various quantities are derived in a simple and straightforward fashion. A.

539.14 : 539.12

ANALYSIS OF PROTON SCATTERING BY LIGHT NUCLEI. See Abstr. 5195-200

539.14

5257. THE CLASSIFICATION OF STATES OF SURFACE VIBRATIONS [IN NUCLEI]. G.Rakavy.
Nuclear Phys., Vol. 4, No. 3, 289-94 (Sept., 1957).

The classification of surface oscillations in nuclei is improved by introducing an additional quantum number which is specially suitable for the treatment of "γ-unstable oscillations" (Abstr. 4580/1956). A selection rule implied by this quantum number is discussed. A.

539.14 : 539.12

EFFECT OF THE DIFFUSENESS OF THE NUCLEAR BOUNDARY ON NEUTRON SCATTERING. See Abstr. 5206

539.14

5258. PROTON POTENTIAL ANOMALY AND NUCLEAR RADIUS CONSTANT FOR MIRROR NUCLEI.
P.C.Sood and A.E.S.Green.
Nuclear Phys., Vol. 5, No. 1, 274-87 (Jan., 1958).

The static diffuse boundary potential well is adjusted to reproduce the binding energies of the last neutrons and protons in mirror nuclei. The corresponding realistic wave-functions, including the effects of reduced mass, spin—orbit interaction and

Coulomb perturbation, are used to calculate the Coulomb energy differences for these nuclei. The exchange effect is taken into account by introducing an exchange correction factor based on a study with harmonic oscillator wave-functions. The theoretical results are compared with the experimental values obtained from the atomic mass data and the agreement is found to be quite good. It is concluded that no appreciable proton potential anomaly exists in this region, i.e. the proton and neutron nuclear potentials are the same. The nuclear radii, as predicted by this model, are found to be in very good agreement with the results of Stanford electron-scattering experiments on five even-nuclei in this region. The calculations are carried out for the mirror nuclei, and a least-square fit for the equivalent uniform radius R gives the value 1.31×10^{-13} cm for the nuclear radius constant $r_0 = RA^{-1/3}$ for these nuclei; this is compared with the results of earlier studies. The possible systematics of the variation of the radius constant with mass number are described and the significance of a larger radius constant for light nuclei is discussed. A.

539.14

5259. ROTATIONAL SPECTRA OF NUCLEI FOLLOWING O^{16}. G.Rakavy.
Nuclear Phys., Vol. 4, No. 3, 375-94 (Sept., 1957).

The possibility of the application of the strong-coupling collective model (rotational model) to nuclei in the region following O^{16} (s–d shells) is discussed. A calculation shows that nuclei with big deformations may be expected in the region considered. In the light of this result the experimental data on nuclei up to A = 25 are reviewed, and it is shown that they are consistent with the general implications of the model. A.

539.14 : 539.17

5260. UNIFIED NUCLEAR MODEL AND DIRECT NUCLEAR PHOTOEFFECT. I. WEAK COUPLING EFFECTS. J.Sawicki.
Nuclear Phys., Vol. 6, No. 3, 525-30 (April [1], 1958).

A contribution to the direct E1 nuclear photoeffect coming from the indirect interaction via the electric quadrupole moment of the core is discussed. The oscillating core absorbs the incoming γ-ray and emits a surfon which is subsequently reabsorbed with the emission of the proton. The interference term between this two-stage mechanism contribution and the usual E1-amplitude in the angular distribution is estimated in two particular cases to amount to a large fraction of the usual E1-term. A.

539.14

5261. NUCLEAR ENERGIES AND THE SHELL MODEL. N.Zeldes.
Nuclear Phys., Vol. 7, No. 1, 27-110 (June [1], 1958).

Various nuclear energy data are interpreted according to the shell model in its simplest form, characterized by the "single-particle" approximation (states of seniority 0 for the even group and seniority 1 for the odd group). The information gained thereby is applied in discussing the problem of the competition between nuclear shells. A.

539.14 : 539.17

INDEPENDENT-PARTICLE MODEL EXPLANATION OF GIANT PHOTONUCLEAR RESONANCE BROADENING. See Abstr. 4317

539.14

5262. SINGLE-PARTICLE ENERGY AND EFFECTIVE MASS AND THE BINDING ENERGY OF MANY-BODY SYSTEMS. K.A.Brueckner.
Phys. Rev., Vol. 110, No. 3, 597-600 (May 1, 1958).

The relationship between the single-particle energy and effective mass and the binding energy of the many-particle nuclear system is discussed. It is shown that only in the case of first order perturbation theory is it possible to define a physically meaningful single-particle energy $E(p)$ so that both relationships, $E(p_F) = (p^2/2M) + V(p_F) = E_{average}$ and $NE_{average} = (p^2/2M)_{average} + \frac{1}{2}[V(p)]_{average}$, are satisfied. More generally a correction term appears, as a result of important many-body contributions to the single-particle energy which arise from the effects of the exclusion principle and from the variation of the self-consistent excitation spectrum with density. The principal effect of the correction is to alter the relationship between $E_{average}$ and the average value of the single-particle energy. Analysis of the optical potential which determines the momentum of a nucleon interacting with the nucleus shows that the same correction term again appears, changing the usual definition of the optical potential. An additional consequence is that it is not possible to fix the effective mass for particle motion from knowledge of the average binding energy and kinetic energy alone, the first order theory underestimating the effective mass by 38% in nuclear matter and by 77% in liquid He^3. A.

539.14

5263. VARIATIONAL WAVE FUNCTION FOR NUCLEAR MATTER. M.Rotenberg and L.Wilets.
Phys. Rev., Vol. 110, No. 5, 1126-30 (June 1, 1958).

A variational wave-function for large nuclear systems is proposed. The function is written as a product of plane wave and deuteron-like functions. The exclusion principle is conveniently introduced by explicitly cutting out overlap between the plane wave and pair states in a manner equivalent to antisymmetrization. The method is limited to nonsingular potentials. Numerical calculations with saturating Yukawa potentials yield a correlation energy of 1.1 MeV per particle at low density, decreasing with increasing density. The method of introduction of the exclusion principle is applied to a qualitative discussion of elastic scattering by a complex projectile, e.g. an alpha-particle. The distortion of the projectile wave-function due to the exclusion of low-momentum components reduces the depth of an effective optical potential with respect to the sum of the potentials seen by the component nucleons. A.

539.14

5264. COLLECTIVE MOTION IN THE NUCLEAR SHELL MODEL. I. CLASSIFICATION SCHEMES FOR STATES OF MIXED CONFIGURATIONS. J.P.Elliott.
Proc. Roy. Soc. A, Vol. 245, 128-45 (May 6, 1958).

To understand how collective motion can develop in the shell-model framework it is necessary to study configuration interaction. With this in mind, group-theoretical methods are used to investigate the possible classification schemes for a number of nucleons in mixed configurations. One particular coupling scheme, which is associated with the degeneracy of a harmonic oscillator potential and which, in a following paper, will be shown to have collective properties is described in detail. The wave-functions in this scheme are seen to be very similar to those resulting from an actual shell-model calculation with configurational mixing. A.

539.14

5265. COLLECTIVE MOTION IN THE NUCLEAR SHELL MODEL. II. THE INTRODUCTION OF INTRINSIC WAVE-FUNCTIONS. J.P.Elliott.
Proc. Roy. Soc. A, Vol. 245, No. 1243, 562-81 (1958).

The wave-functions for a number of particles in a degenerate oscillator level, classified in Pt I according to irreducible representations of the group U_3, are expressed as integrals of the Hill–Wheeler type over intrinsic states. The rotational band structure which appeared in the classification is now understood, since all states of a band are shown to involve the same intrinsic state in the integral. It is possible to use the quantum number K of the intrinsic states as an additional label for the final wave-functions, thus distinguishing states which, in the classification of Pt I, had the same values for all other quantum numbers used. The integral form for the wave-functions enables simple expressions to be obtained for the quadrupole moments which resemble those of the rotational model for a permanent deformation. A.

539.14

5266. A RELATIONSHIP BETWEEN "PARTICLE" AND "HOLE" MATRIX ELEMENTS IN THE NUCLEAR SHELL THEORY. V.G.Neudachin.
Zh. éksper. teor. Fiz., Vol. 33, No. 4(10), 918-22 (1957). In Russian.

A relationship between the matrix elements for "particle" configurations and "hole" configurations is considered for pair operators — non-central interactions of the general type. The following particular cases are considered: central, tensor and spin–orbital forces. The connection between single-particle operator matrix elements is briefly discussed. A.

539.14 : 530.145

UNIFIED MODEL, ANISOTROPIC HARMONIC OSCILLATOR TREATMENT. See Abstr. 4758

539.14

5267. SPINS OF SILVER-105, SILVER-106, AND SILVER-110 m. W.B.Ewbank, W.A.Nierenberg, H.A.Shugart and H.B.Silsbee.
Phys. Rev., Vol. 110, No. 2, 595-6 (April 15, 1958).

The spins of three radioactive silver isotopes Ag^{105}, Ag^{106} and 253 day metastable Ag^{110} were determined by an atomic beam technique. Ag^{105} is shown to have $I = \frac{1}{2}$ and Ag^{106} and Ag^{110} $I = 6$. L.L.Green

539.14 : 539.2

SPIN AND MOMENTS OF Pr^{141}, Tb^{159} AND Ho^{167}. See Abstr. 4441

539.14

5268. NUCLEAR MAGNETIC MOMENTS AND THE MANY BODY PROBLEM. J.S.Bell.
Nuclear Phys., Vol. 4, No. 3, 295-312 (Sept., 1957).

The Brueckner theory predicts corrections to the shell model moments of even such simple nuclei as N^{15}, O^{17}, and K^{39}. Calculation is difficult because of the many states excited by the model operator. To obtain some notion of orders of magnitude a simple model is examined in which the core is represented by a uniform Fermi gas; the summations then become integrals in momentum space. It is assumed, as is usual in shell-model work, that the effective two-body potential can be crudely represented by a static central potential with exchange. The second-order corrections are found to be of the same order of magnitude as, but somewhat smaller than, the effect in first order of the usual space-exchange current. A.

539.14

5269. GYROMAGNETIC RATIO OF 2^+ ROTATIONAL STATES. G.Goldring and R.P.Scharenberg.
Phys. Rev., Vol. 110, No. 3, 701-7 (May 1, 1958).

The angular distribution of gamma-rays following Coulomb excitation of millimicrosecond 2^+ states in Nd^{150}, Sm^{152}, Sm^{154}, Gd^{154}, Gd^{156} and Gd^{160} were investigated. The gamma-ray angular distributions from solid oxide targets showed substantial perturbations. The attenuation coefficients for liquid nitrate targets were measured to be: Nd^{150}, $G_2^L = 1 \pm 0.035$; Sm^{152}, $G_2^L = 1 \pm 0.035$; Sm^{154}, $G_2^L = 1.1 \pm 0.10$; Gd^{154}, $G_2^L = 0.5 \pm 0.06$; Gd^{156}, $G_2^L = 0.6 \pm 0.04$; Gd^{160}, $G_2^L = 0.6 \pm 0.06$. The influence of the paramagnetic ion and the liquid environment on the angular distributions are discussed. The effect of an external magnetic field (H_{ex}) on the unperturbed gamma-ray angular distribution from liquid targets was measured. The effect was attributed to the precession of the excited nucleus (gyromagnetic ratio g) in the external magnetic field that has been modified by the atomic structure (H_{eff}). For Nd^{150}, $H_{eff} = (2.3 \pm 0.3)H_{ex}$, $g = 0.22 \pm 0.04$; Sm^{152}, $H_{eff} = (1.7 \pm 0.2)H_{ex}$, $g = 0.21 \pm 0.04$; Sm^{154}, $H_{eff} = (1.7 \pm 0.2)H_{ex}$, $g = 0.21 \pm 0.04$. A.

539.14

5270. ELECTRIC DIPOLE MOMENT ASSOCIATED WITH OCTUPOLE VIBRATIONS OF A SPHEROIDAL NUCLEUS. A.Bohr and B.R.Mottelson.
Nuclear Phys., Vol. 4, No. 4, 529-31 (Oct., 1957).

The electric-dipole transition probability associated with collective odd-parity transitions is estimated on the basis of the polarization induced by the electric field of the nuclear deformation. The available experimental data are discussed in an attempt to obtain information on the nuclear octupole distortion. A.

539.14

5271. A SEMI-EMPIRICAL FORMULA FOR THE NUCLEAR RADIUS. L.R.B.Elton.
Nuclear Phys., Vol. 5, No. 1, 173-8 (Jan., 1958).

It is shown that the experimental results on negatron and proton scattering by nuclei are in agreement with the assumptions that the central density of nuclear matter is constant for all nuclides and that the neutron and proton distributions in a nucleus are the same. A.

539.14 : 539.12

5272. NUCLEAR RADII BY SCATTERING OF LOW-ENERGY NEUTRONS. K.K.Seth, D.J.Hughes, R.L.Zimmerman and R.C.Garth.
Phys. Rev., Vol. 110, No. 3, 692-700 (May 1, 1958).

The potential scattering cross-section for slow neutrons, σ_p, was measured for seventeen elements in order to determine the nuclear potential radius and to investigate the predictions of nuclear optical models. The measurements were based on total cross-sections resulting from transmission experiments performed with the Brookhaven fast chopper. In the energy region where individual resonances can be resolved and their parameters determined with reasonable accuracy, σ_p is obtained by subtracting the resonance contribution, including interference effects, from the measured total cross-section. In the key region, where the chopper resolution permits determination of cross-sections averaged over many resonances only, different sample thicknesses are used and σ_p derived from the slope of the transmission curve. The results in the two energy regions agree, thereby justifying the concept of potential scattering as a cross-section constant with energy, once effects of nearby resonances are removed. The variation of potential scattering with atomic weight is compared with predictions of optical models of the nucleus. The data reflect rather strongly the effects of the deformation of the nuclear shape from spherical, and good agreement is obtained for a potential well with a diffuse surface and nuclear deformations corresponding to known quadrupole moments. The radius of the potential (the distance to its half-value) is given by $R = r_0 A^{1/3}$, with $r_0 = (1.35 \pm 0.04) \times 10^{-13}$ cm. The radius parameter r_0 is thus distinctly larger than the 1.09×10^{-13} cms obtained from electron scattering experiments. A.

539.14 : 539.163.2

5273. LOW LYING LEVELS IN Th^{228}. S.Bjørnholm, O.Nathan, O.B.Nielsen and R.K.Sheline.
Nuclear Phys., Vol. 4, No. 3, 313-24 (Sept., 1957).

The decay scheme $Ac^{228} \rightarrow Th^{228}$ was reinvestigated. The observation of new conversion lines and coincidence relations establish a revised decay scheme. An analysis of the level scheme in the light of the unified model classifies the levels as members of two rotational bands above the ground state band. Two states of energies 328 and 396 keV with $K = 0$ and $I = 1^-$ and 3^- are interpreted as an octupole vibrational band, and states at 966 and 1018 keV with $K = 2$ and $I = 2^+$ and 3^+ as a γ-vibrational band. The presence of a second octupole vibrational band with $K = 2$ and $I = 2^-$, 3^-, ... is suggested. The close similarity with the level schemes of other strongly deformed nuclei in the actinide as well as in the lanthanide regions is emphasized. A.

539.14

5274. THE 3^- LEVEL IN A^{40}. R.Thieberger and A.de-Shalit.
Nuclear Phys., Vol. 4, No. 3, 469-71 (Sept., 1957).

The calculation of the 3^- level in A^{40} is attempted. The calculation is based on comparing energy levels in neighbouring nuclei. The result obtained is 2.51 MeV. A.

539.14

5275. EXCITED STATES OF N^{16}. J.M.Freeman and R.C.Hanna.
Nuclear Phys., Vol. 4, No. 4, 599-614 (Oct., 1957).

The first four levels of N^{16}, excited by the reaction $N^{15}(d,p)N^{16}$, were studied by observing proton groups and gamma-radiation, coincidences and angular correlations. The following spins and energies have been assigned to the excited states: 0^- at 120 ± 1 keV, 3^- at 298 ± 5 keV and 1^- at 395 ± 3 keV. The half-life of the 120 keV level is 6.7 ± 0.5 microseconds. The results are in excellent agreement with the shell-model predictions of Elliott and Flowers. A.

539.14 : 539.163.2

5276. EXCITED STATES OF Eu^{153}. C.W.McCutchen.
Nuclear Phys., Vol. 5, No. 1, 187-94 (Jan., 1958).

The β-decay of Sm^{153} and the electron capture Gd^{153} were studied with a NaL scintillation spectrometer, with a xenon proportional counter used with and without escape gating, and with a conversion-electron proportional counter. The two decay schemes were verified and, in one case, extended. From a measurement of its internal-conversion coefficient the 97 keV γ in the Gd^{153} decay is shown to be E1. The decay schemes and multipolarities are shown to be inconsistent with any likely spin sequence for Eu^{153} and ground state spin of Gd^{153}. A.

539.14

5277. THE ENERGY LEVELS OF Dy^{160}. S.Ofer.
Nuclear Phys., Vol. 5, No. 2, 331-45 (Jan. [2], 1958).

A study of the γ-ray transitions between levels of Dy^{160} resulting from the decay of Tb^{160} has been made using fast–slow coincidence technique. The angular correlations of six γ-ray cascades were measured. A decay scheme is suggested and assignments for the spins of excited levels and the multipolarities of the γ-radiations are made. The results support the suggestion that the 970 keV and 1050 keV levels should be interpreted as collective vibrational levels. A.

539.14 : 539.163.2

5278. A CONTRIBUTION TO THE ESTABLISHMENT OF THE LEVEL SCHEME OF RADIUM C'. G.R.Bishop.
Nuclear Phys., Vol. 5, No. 2, 358-82 (Jan. [2], 1958).

The gamma-rays of radium C' and beta-rays of radium C were studied by scintillator techniques. A decay scheme is proposed which is based on internal conversion coefficients, angular correlations between cascade gamma-rays, and transition probabilities derived from the alpha-particle fine structure. There is some evidence that collective effects occur in this nucleus. A.

539.14

5279. ON THE LEVEL DENSITY OF DEFORMED NUCLEI. T.Ericson.
Nuclear Phys., Vol. 6, No. 1, 62-81 (March [2], 1958).

A simplified unified model is applied to a statistical calculation of the level densities of deformed nuclei. Configurations of nucleons of the same kind and in the same orbit are favoured by a pairing energy. With increasing energy more and more pairs are broken and the spin and parity of the levels are entirely determined by the unpaired nucleons and the collective modes of excitation. The validity of the model at higher excitation is discussed. The parameters entering the final expression for the level density are known in principle. A.

539.14

5280. SELECTION RULES FOR ELECTROMAGNETIC TRANSITIONS IN DEFORMED NUCLEI. M.E.Volkhanskiĭ.
Zh. éksper. teor. Fiz., Vol. 33, No. 4(10), 1004-9 (1957). In Russian.

Selection rules were obtained for electromagnetic transitions in strongly deformed nuclei according for asymptotic quantum numbers: n_Z — the quantum oscillations along the axis of symmetry of the nucleus, N — the principal oscillator quantum number, Ω, Λ, Σ — the quantum numbers of projections of the total, orbital and spin moments onto the axis of symmetry of the nucleus. It is shown that account taken of the selection rules for N, n_Z, Λ, Σ enables one to explain the discrepancies between experimental and theoretical values of the probabilities of electromagnetic transitions. Prohibition for one of the asymptotic quantum numbers reduces the probability of a transition tenfold and more. A.

539.14

5281. LIFETIME OF THE FIRST ROTATIONAL STATE OF Gd^{156}. O.Nathan.
Nuclear Phys., Vol. 5, No. 2, 401-4 (Jan. [2], 1958).

The half-life of the 89 keV state of Gd^{156} was measured by means of a fast—slow coincidence circuit. From the observed value of $(1.9 \pm 0.1) \times 10^{-9}$ sec the reduced E2-transition probability can be calculated. One finds $B(E2; I_0 \rightarrow I_f) : e^2 = (5.1 \pm 0.3) \times 10^{-48}\ cm^4$ in good agreement with the Coulomb excitation result of Ramšak et al. A.

539.14

5282. LIFETIME OF A 1^- LEVEL IN Sm^{152}. L.Grodzins.
Phys. Rev., Vol. 109, No. 3, 1014-15 (Feb. 1, 1958).

A measurement of the cross-section for the resonance scattering by Sm of the 961 keV E1 γ-ray excited in the decay of 9.3 hr Eu^{152} leads to a mean lifetime for this level of $(3 \pm 1) \times 10^{-14}$ sec. M.A.Grace

539.14

5283. LIFETIME OF THE FIRST EXCITED STATE OF B^{11}. F.R.Metzger, C.P.Swann and V.K.Rasmussen.
Phys. Rev., Vol. 110, No. 4, 906-9, (May 15, 1958).

Using the reaction $B^{11}(p,p')B^{11*}$ as the source of Doppler-broadened 2.14 MeV gamma radiation, resonance fluorescence from the first excited state of B^{11} was observed. For a bombarding energy of 3.0 MeV and a thick target of B_4C, the shape of the cone containing gamma-rays capable of exciting the 2.14 MeV level was determined. It agrees with the expectation based on the known excitation curve and the kinematics of the $B^{11}(p,p')$ reaction assuming an isotropic distribution of the B^{11*} recoils. From the experimental resonance sacttering cross-section a mean life of 4.8×10^{-15} sec was calculated for the first excited state of B^{11}, assuming the spin of this level to be $\frac{1}{2}$. A self-absorption experiment yielded $\tau_\gamma = 4.3 \times 10^{-15}$ sec when a value of 1250° was used for the Debye temperature of B_4C. A final value of $(4.7 \pm 0.6) \times 10^{-15}$ sec was adopted for the mean life of the 2.14 MeV first excited state of B^{11}. This value of the lifetime further strengthens the argument for spin $\frac{1}{2}$, but it does not allow any conclusion about the M1 or E1 character of the gamma-ray transition and thus about the parity of the 2.14 MeV level. A.

539.14

5284. REMARKS ON THE HYPERTRITON.
R.H.Dalitz and B.W.Downs.
Phys. Rev., Vol. 110, No. 4, 958-65 (May 15, 1958).

The structure of the S-states possible for a system consisting of a Λ particle and two nucleons is discussed, and criteria are laid down for a trial wave-function suitable for describing the orbital motion. In order to obtain an upper bound for the Λ-nucleon interaction strength, variational calculations are carried through for the hypertriton with a simple trial function. Following the discussion of the results, it is concluded that it is very unlikely that there should exist bound states for the hyperdeuteron or for $_\Lambda He^3$. A.

539.14

5285. CONTRIBUTION OF THREE-BODY FORCES TO THE BINDING OF HYPERFRAGMENTS. R.Spitzer.
Phys. Rev., Vol. 110, No. 5, 1190-1 (June 1, 1958).

The potential energy of Λ in the hypertriton due to two- and three-body pion-exchange forces is estimated. The contributions from the two types of forces are found to be of the same order of magnitude, thus indicating that the three-body force produces the binding of Λ in the hypertriton. The role of the three-body force in the binding of other light hyperfragments is briefly discussed. A.

539.14

5286. MESONIC DECAY OF A TRITIUM HYPERFRAGMENT. A.O.Vaĭsenberg and V.A.Smirnitskiĭ.
Zh. éksper. teor. Fiz., Vol. 32, No. 4, 736-7 (1957). In Russian.
English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 4, 607-8 (Nov., 1957).

An analysis is made of the mesonic decay of a hyperfragment according to the scheme

$$_\Lambda{}^0H^{3*} \rightarrow p + p + n + \pi^- + Q,$$

where $Q = 35.9 + 0.7$ MeV. A.

539.14 : 538.114

ORIENTATION OF NUCLEI IN FERROMAGNETS.
See Abstr. 5107

539.14

5287. DYNAMIC POLARIZATION OF Si^{29} NUCLEI IN SILICON. A.Abragam, J.Combrisson and I.Solomon.
C.R. Acad. Sci. (Paris), Vol. 246, No. 7, 1035-7 (Feb. 17, 1958). In French.

The extension of the Overhauser effect to semiconductors has enabled the nuclear resonance signal due to Si^{29} in saturating the resonance of conduction electrons in Si to be increased. The nuclear polarization thus achieved lasts for several minutes at normal temperatures. C.A.Hogarth

539.14

5288. NUCLEAR RESONANCE SIGNALS OBTAINED BY DYNAMIC POLARIZATION. A.Landesman.
C.R. Acad. Sci. (Paris), Vol. 246, No. 10, 1538-40 (March 10, 1958). In French.

Nuclear resonance is observed in several systems of coupled nuclear and electron spins. The nuclear magnetic resonance signal is observed to be enhanced by dynamic polarization produced by saturation of the electron spin resonance. Nuclear magnetic resonance was observed of protons in $K_2(SO_3)_2NO$ solutions, of fluorine nuclei in organic substances such as $C_6H_4(CF_3)_2$, and of lithium nuclei in solutions of lithium hydroxide. All of the measurements were done in an external field of 72 Oe. J.M.Baker

539.14

5289. NUCLEAR MAGNETIC RESONANCE APPLIED TO CHEMICAL PROBLEMS. H.S.Gutowsky.
Disc. Faraday Soc., No. 19, 187-92 (1955).

The basic nuclear magnetic resonance experiment is described and a summary is given of applications to problems in chemical structure. The absorption line shapes and their temperature dependence in solids provide information on internuclear distances and the types of molecular motion in solids. The spin-lattice relaxation time T_1 gives detailed values for the frequencies of lattice motions, and is useful in evaluating potential barriers or activation energies associated with the motions. The electronic environment of nuclei causes several effects of which the most important are probably the chemical shifts and the indirect spin—spin multiplets. In liquids, these effects give resolvable complex spectra which are being used increasingly for structural analysis. Another very useful phenomenon is provided by chemical exchange which averages out these electronic interactions so that chemical lifetimes of the order of 1 to 10^{-5} sec can be measured. The general future of nuclear magnetic resonance in chemical research is discussed. A.

539.14

5290. ROTATIONAL NARROWING IN NUCLEAR MAGNETIC RESONANCE. J.I.Kaplan.
J. chem. Phys., Vol. 27, No. 6, 1426 (Dec., 1957).

Demonstrates, theoretically, that periodic rotation is generally more effective than random rotation in producing narrowing. D.J.Oliver

539.14 : 539.164.07 : 537.534.3

APPLICATION OF NUCLEAR MAGNETIC RESONANCE TO FIELD MONITORING AND CONTROL IN MASS AND ALPHA SPECTROMETRY. See Abstr. 5060

RADIOACTIVITY

539.16

5291. RADIOISOTOPES IN SCIENTIFIC RESEARCH. UNESCO CONFERENCE. H.Seligman.
Nature (London), Vol. 180, 1029 (Nov. 16, 1957).

This report summarizes the proceedings of an International Conference held in Paris during September 9-20, 1957. The conference, which was arranged by UNESCO, was attended by scientists from 61 countries. After the opening by Sir John Cockcroft, all meetings were divided between the physical and biological sciences, except for two plenary sessions. The report deals mainly with the physical sciences. Over 100 papers were read in these sessions. The subjects dealt with included new methods of isotope production and applications of radioisotopes to solid-state physics, all branches of chemistry, geophysics and research into parity problems in nuclear physics. Two plenary sessions dealt with methods and techniques and two private symposia were held on the production of isotopes and on residual radioactivity in the finished products.

D.R.Chick

539.16 : 539.12

5292. NEUTRON EMISSION BY EXCITED RaD NUCLEI.
A.V.Kogan and L.I.Rusinov.
Zh. éksper. teor. Fiz., Vol. 32, No. 3, 432-9 (1957). In Russian.
English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 3, 365-71 (Oct., 1957).

Neutron emission from an active deposit of radium emanation on pure heavy metals was investigated. It is shown that the observed neutron activity is related to disintegration of the RaC'' isotope. The neutrons are apparently emitted by excited RaD nuclei produced as a result of β-disintegration of RaC''. Control experiments were carried out which permit one to estimate the contribution of other possible processes to the neutron radiation from the short-lived active radon deposit. A.

539.163

5293. ANOMALOUS RADIATIONS EMITTED BY SOME RADIONUCLIDES. M.Ader.
Ann. Phys. (Paris), Sér. 13, Vol. 2, No. 9-10, 611-30 (Sept.-Oct., 1957). In French.

A study of long-range particles emitted by Po, Th, RdAc (Th^{227}), Ra, RaD (Pb^{210}), Pu, and U. A.O.Stanesby

539.163

5294. SCANDIUM ISOTOPE OF MASS 42.
J.A.R.Cloutier and A.Henrikson.
Canad. J. Phys., Vol. 35, No. 10, 1190-8 (Oct., 1957).

A member of the odd-odd Z = N family, Sc^{42}, was produced by proton bombardment of a calcium target greatly enriched in Ca^{42}. The positron emission, which alone is observed, has a measured half-life of 0.68 sec, end point 4.8 MeV, and threshold 6.8 MeV. The superallowed transition is between ground states (J,T) tentatively described as $Sc^{42}(0^+,1)$ and $Ca^{42}(0^+,1)$. A.

539.163

5295. NUCLEAR SPECTROSCOPIC INVESTIGATIONS OF THE NUCLIDES $^{228}_{90}Th$, $^{224}_{88}Ra$, $^{212}_{82}Pb$, $^{212}_{83}Bi$, $^{208}_{81}Tl$.
F.Demichelis, B.Chinaglia and G.Trivero.
Nuovo Cimento, Vol. 8, No. 3, 369-77 (May 1, 1958).

The γ spectrum of Th^{228} in equilibrium with its decay products was investigated by means of two scintillation spectrometers and a fast slow coincidence set up in the range 0.05-0.76 MeV. The results confirm the decay schemes of the nuclides Pb^{212} and Th^{228}. For the nuclides Ra^{224} and Bi^{212} the existence of two γ-rays, which fit the energy levels already proposed by other authors, is ascertained through a direct measurement. Some unknown γ-rays were found which must be assigned to the $Tl^{208} \rightarrow Pb^{208}$ decay. According to these data a new decay scheme for Tl^{208} is proposed. A.

539.163

5296. CONVERSION-ELECTRON AND PHOTON SPECTRA OF Gd^{147} AND Gd^{149}. V.S.Shirley, W.G.Smith and J.O.Rasmussen.
Nuclear Phys., Vol. 4, No. 3, 395-407 (Sept., 1957).

A new gadolinium isotope decaying by electron capture with a 29-hour half-life was found. Its mass number was determined to be 147 by examination of its excitation function for production by alpha-particle bombardment of $Sm_2{}^{147}O_3$. The electron-capture isotope Gd^{149} was also studied, and its half-life was re-determined to be 9.3 ± 0.3 days. The conversion-electron and photon spectra of Gd^{147} and Gd^{149} were studied. Relative photon and electron intensities were determined for some of the transitions, and some coincidence measurements were made. From the data a few multipolarities are assigned and partial decay schemes are suggested. A.

539.163

5297. DECAY OF TELLURIUM-132.
G.D.Cheever, W.S.Koski, D.R.Tilley and L.Madansky.
Phys. Rev., Vol. 110, No. 4, 922-3 (May 15, 1958).

The decay of Te^{132} produced by fission of uranium was investigated by using a scintillation spectrometer. In addition to the previously reported 0.23 MeV gamma-ray and the iodine K X-ray, a 0.053 MeV gamma-ray was observed. Coincidence measurements permitted the determination of K-shell conversion coefficients for the two transitions. Probable decay schemes compatible with the observations are discussed. A.

539.163

5298. NATURAL RADIOACTIVITY OF V^{50} AND Ta^{180}.
E.R.Bauminger and S.G.Cohen.
Phys. Rev., Vol. 110, No. 4, 953-7 (May 15, 1958).

The methods of proportional counter and scintillation spectroscopy were used to examine the possible radioactivity of the naturally occurring nuclides V^{50} and Ta^{180}. Some positive evidence is obtained that V^{50} decays by K capture to the 1.58 MeV excited state of Ti^{50} with a half-life of $(4.8 \pm 1.2) \times 10^{14}$ yr. A search for titanium K X-rays gave negative results. For Ta^{180} a lower limit of $(2.3 \pm 0.7) \times 10^{13}$ years was found for the half-life against decay by K capture and a lower limit of $(1.7 \pm 0.6) \times 10^{13}$ years against beta decay. A.

539.163.1

5299. FAST E_2 TRANSITION IN Ra^{224}. H.Vartapetian.
C.R. Acad. Sci. (Paris), Vol. 246, No. 12, 1846-7 (March 24, 1958). In French.

The half-life of the 84 keV E_2 level in Ra^{224} was measured using a fast coincidence technique to determine the displacement of the α—γ, 84 keV, resolution curve of Ra^{224} from a similar curve (β—γ, 411 keV Compton) from Au^{198}. From the result, the reduced probability of the transition was determined, and an estimate made of the intrinsic quadrupole moment and deformation. As predicted, the quadrupole moment and deformation are less for Ra^{224} than for Ra^{226}. A.E.I. Research Laboratory

539.163.1

5300. THE LIFETIME OF THE FIRST EXCITED STATE OF MOLYBDENUM 95. J.Quidort.
C.R. Acad. Sci. (Paris), Vol. 246, No. 14, 2119-20 (April 9, 1958). In French.

Delayed γ—γ coincidence measurements using NaI(Tl) scintillation counters show that the lifetime of this state is $(7.7 \pm 0.3) \times 10^{-10}$ sec. M.A.Grace

539.163.1

5301. HALF-LIFE OF K^{37}. F.Schweizer.
Phys. Rev., Vol. 110, No. 6, 1414-15 (June 15, 1958).

A more accurate value of the half-life of K^{37} is 1.23 × 0.02 sec, in agreement with the value reported by Sun and Wright. The Gamow—Teller matrix element is recalculated using new values of the coupling constants, and is found to be in agreement with the theoretical value calculated by Winther and Kofoed-Hansen from the shell model. The experimental method is described in detail. A.

539.163.2

5302. THE DECAY OF ^{109}Cd, ^{109}Ag AND ^{109}Pd.
A.H.Wapstra and W.van der Eijk.
Nuclear Phys., Vol. 4, No. 3, 325-9 (Sept., 1957).

The K conversion coefficient of the 88 keV E3 gamma-ray in Ag^{109*} is found to be 10.3 ± 0.5. The theoretical value is 11.6. The electron-capture decay energy of Cd^{109} to this level of 75^{+15}_{-10} keV is obtained from the ratio of K and L capture. Gamma-rays of 305 and 410 keV which could originate from known levels at these energies in Ag^{109} occur for 0.07% and < 0.03% per decay of Pd^{109}. A.

539.163.2

5303. DECAY SCHEME OF Pb^{212}. E.M.Krisyouk, A.G.Sergeyev, G.D.Latyshev and V.D.Vorobyov.
Nuclear Phys., Vol. 4, No. 4, 579-88 (Oct., 1957).

The decay scheme of Pb^{212} β Bi^{212} is analysed It is shown that Bi^{212} has the following levels: 0 keV — 1⁻, 239 keV — 0⁻, 300 keV — 1⁻, 415 keV — 0⁻. The spin and parity assignments are based on the γ-transition multipolarities and computed log τf values for β-transitions. Configurations which can be ascribed to the levels on basis of the shell model qualitatively explain the

γ-transition intensities. The proposed decay scheme implies that the 177 keV transition is an E0-transition; this is compatible with presently available data. A.

539.163.2

5304. GAMMA RADIATION FROM ^{141}Nd. H.L.Polak, W.Schoo, B.L.Schram, R.K.Girgis and R.van Lieshout.
Nuclear Phys., Vol. 5, No. 1, 271-3 (Jan., 1958).

A scintillation spectrometer study of the disintegration of Nd^{141} produced by a (d, 2n) reaction on Pr^{141}, shows that it decays mainly by electron capture, accompanied by a weak positron group (1.9%); two weak gamma-rays with energies of 1.14 MeV (0.50%) and 1.30 MeV (0.26%) were found. A decay scheme is proposed for Nd^{141}. A.

539.163.2

5305. DECAY SCHEME OF 50-DAY Re^{184}.
C.J.Gallagher, Jr, D.Strominger and J.P.Unik.
Phys. Rev., Vol. 110, No. 3, 725-32 (May 1, 1958).

A detailed study of the radiations of Re^{184} decay is given. The decay is found to be complex, with most of the direct decay populating the 2+ and 3+ levels at 904 and 1006 keV in W^{184}. A decay scheme is presented which includes all of the strong transitions, but several weak transitions remain unplaced. Several tests of the unified-model predictions are made. Data on the K-Auger electrons of tungsten are given. Some incidental studies of Re^{183} are also presented. The half-life value of Re^{183} is found to be 71 days, in disagreement with previous values. A.

539.163.2

5306. DECAY OF SELENIUM-72.
J.B.Cumming and N.R.Johnson.
Phys. Rev., Vol. 110, No. 5, 1104-8 (June 1, 1958).

Se^{72} was observed to decay by electron capture with a half-life of 8.40 ± 0.08 days, predominantly to an excited state in As^{72} at 46.0 ± 0.3 keV. The half-life of this state is less than 1.5×10^{-8} sec. Less than 7% of the Se^{72} decays are to the ground state. The K-conversion coefficient of the 46 keV gamma was measured to be 0.63 ± 0.06 and the K/L conversion ratio to be 9.7 ± 0.5. The upper limit, 0.1%, obtained for the abundance of positrons places a maximum value on the decay energy of 1.2 MeV, which corresponds to a maximum log ft of 5.7. On these grounds the excited state is assigned a 1+ spin and the gamma transition is E1. In the course of these measurements, the ratio of intensities of X-rays to 46 keV gamma rays in the decay of RaD.(Pb^{210}) was redetermined to be 5.38 ± 0.50. A.

539.163.2

5307. DECAY OF Er^{171}.
F.P.Cranston, Jr, M.E.Bunker and J.W.Starner.
Phys. Rev., Vol. 110, No. 6, 1427-38 (June 15, 1958).

The decay of Er^{171} (7.52 hours) was studied with beta and gamma scintillation spectrometers, a magnetic lens spectrometer, and a 180° permanent-magnet spectrograph. A number of previously unobserved beta-ray and gamma-ray transitions were found. On the basis of coincidence studies, intensity data, internal conversion coefficients, and the measured transition energies, a consistent level scheme for Tm^{171} is proposed which has excited states at energies of 0.0051, 0.1167, 0.1291, 0.4251, 0.636, 0.688, 0.744, 0.921, and 1.008 MeV. The observed states are identified with appropriate orbitals of the Nilsson energy level diagram, and the experimental transition probabilities are examined in terms of the asymptotic selection rules for strongly deformed nuclei. A.

539.163.2

5308. SOME MEASUREMENTS ON THE DECAY OF Mn^{52}.
J.Konijn, B.van Nooijen and H.L.Hagedoorn.
Physica, Vol. 24, No. 5, 377-9 (May, 1958).

A scintillation counter and β-spectrometer were used to measure the ϵ/β^+ ratio (1.99 ± 0.06) which leads to a value of −0.006 ± 0.012 for the Fierz interference term. Internal conversion and energy measurements were also made on the γ-radiation. M.A.Grace

539.163.2 : 539.14

$Ac^{228} \rightarrow Th^{228}$ DECAY SCHEME. See Abstr. 5273

539.163.2 : 539.14

Gd^{153} AND Sm^{153} DECAY SCHEMES. See Abstr. 5276

539.163.2 : 539.14

ESTABLISHMENT OF THE LEVEL SCHEME OF RADIUM C'. See Abstr. 5278

539.164.07 : 539.14 : 537.534.3

APPLICATION OF NUCLEAR MAGNETIC RESONANCE TO FIELD MONITORING AND CONTROL IN ALPHA SPECTROMETRY. See Abstr. 5060

539.165

5309. SPECTRUM OF L AUGER ELECTRONS FROM $_{81}Tl^{200}$ AND $_{83}Bi^{212}$. C.Geoffrion and G.Nadeau.
Canad. J. Phys., Vol. 35, No. 11, 1284-91 (Nov., 1957).

The spectrum of L Auger electrons emitted by a source of Th(B + C + C'') was measured with a 180° beta-ray spectrometer. An empirical formula for the calculation of secondary ionization potentials is used for a tentative identification of the transitions giving rise to the measured lines. A.

539.165 : 539.166 : 530.145

5310. β–γ-CORRELATION FOR ALLOWED TRANSITIONS INVOLVING NON-CONSERVATION OF PARITY.
Yu.V.Gaponov and V.S.Popov.
Nuclear Phys., Vol. 4, No. 3, 453-6 (Sept., 1957).

The angular correlation between the directions of emission of electron and circularly-polarized γ-quantum in cascade β–γ transitions is considered for allowed β-transitions, taking account of parity non-conservation. The effect of the nuclear Coulomb field is neglected. A.

539.165 : 539.166

5311. SELECTION RULES FOR BETA AND GAMMA PARTICLE TRANSITIONS IN STRONGLY DEFORMED NUCLEI.
G.Alaga.
Nuclear Phys., Vol. 4, No. 4, 625-31 (Oct., 1957).

In the present paper a complete list of selection rules is given for beta- and gamma-particle transitions in strongly deformed nuclei. For the beta-decay the list covers all transitions up to the second forbidden ones, while for the gamma-decay the selection rules are given for the electric and magnetic dipole, quadrupole, and octupole transitions. This list represents a slight correction and enlargement of the selection rules given earlier (see Abstr. 1531/1956). A.

539.165 : 539.166.83 : 539.14

5312. MEASUREMENTS ON ISOTOPE SEPARATED β-RAY SOURCES OF Re^{186} AND Re^{188}. K.O.Nielsen and O.B.Nielsen.
Nuclear Phys., Vol. 5, No. 2, 319-30 (Jan.[2], 1958).

Isotopically pure β-ray sources of Re^{186} and Re^{188} were prepared from pile-irradiated natural Re in an isotope separator. The spectrum of the β-rays from Re^{186} to the ground state of Os^{186} was found not to have the allowed shape. The deviations are of the type earlier observed in the decay $Re^{186} \rightarrow Os^{186}$. Both transitions probably proceed from a 1^- to a 0^+ state. The K-conversion lines for the transitions from the 633 keV level in Os^{188} to the ground state and to the 155 keV 2^+ level were observed. The conversion coefficients indicate E2 nature for these transitions in agreement with an angular correlation experiment. The level schemes of Os^{186} and Os^{188} indicate that these nuclei lie in the transitional region between the strongly deformed nuclei and those of spherical equilibrium shape. A.

539.165

5313. MEASUREMENT OF BETA-RAY POLARIZATION OF Au^{198} BY DOUBLE COULOMB SCATTERING.
H.J.Lipkin, S.Cuperman, T.Rothem and A.de-Shalit.
Phys. Rev., Vol. 109, No. 1, 223-4 (Jan. 1, 1958).

The left–right asymmetry in the double scattering of 250 keV β-rays from P^{32} is the same as that for Au^{198} from which it is concluded that both have the full V/C polarization. M.A.Grace

539.165 : 539.166

5314. BETA–GAMMA CIRCULAR POLARIZATION CORRELATION EXPERIMENTS. F.Boehm and A.H.Wapstra.
Phys. Rev., Vol. 109, No. 2, 456-61 (Jan. 15, 1958).

A circular polarization analyser for γ-rays is described. Measurements on circular polarization of bremsstrahlung due to β-particles from P^{32} and Tm^{170} agree with previous and concurrent measurements and, together with Co^{60} circular polarization correlation studies, establish a check on the calculated calibration curve of the analyser. The β–γ circular polarization correlation was studied in the following allowed j–j transitions: Na^{24}, Sc^{44}, Sc^{46}, V^{48}, and Co^{58}. The result for Sc^{46} indicates the presence of a strong interference between Gamow–Teller and Fermi couplings. The β interaction, therefore, should contain a combination of S and T, or (and) V and A, interactions with small or no phase difference between the interaction constants. If one assumes maximum interference, the experiments give information on the ratio of Gamow–Teller to Fermi interaction. The once-forbidden transition Au^{198} gives the maximum possible asymmetry. All results are in agreement with the 2-component neutrino theory and the assumption of V, A or alternatively S, T, P interaction. A.

539.165 : 539.166

5315. INTERFERENCE BETWEEN GAMOW–TELLER AND FERMI INTERACTION IN Mn^{52}. F.Boehm.
Phys. Rev., Vol. 109, No. 3, 1018-19 (Feb. 1, 1958).

The $\beta-\gamma$ circular-polarization correlation technique described in the preceding abstract is applied to Mn^{52}. The value of the asymmetry coefficient found indicates the presence of interference between Gamow–Teller and Fermi interactions in Mn^{52}.

L.L.Green

539.165

5316. BETA-RAY SPECTRUM OF N^{16}.
G.Brunhart, V.P.Kenney and B.D.Kern.
Phys. Rev., Vol. 110, No. 4, 924-6 (May 15, 1958).

The beta-ray spectrum of 7.38 sec N^{16} was investigated with a 180° magnetic spectrometer. The radioactive nuclei were produced by 1.5 MeV dueterons through the reaction $N^{15}(d,p)N^{16}$, using targets of lead nitrate enriched to 64% in N^{15}. Of the four known beta-ray groups, two with end-point energies 10.40 ± 0.05 MeV and 4.39 ± ± 0.07 MeV are satisfactorily resolved. The intensity of the 10.40 MeV group relative to that of the remainder of the transitions is in the ratio of 28:72, leading to log f_0t = 6.67. The 10.40 MeV group is shown to proceed as a first forbidden $\Delta J = 2$ (yes) transition, and thus the ground state of N^{16} may be uniquely designated as a 2^- level. A.

539.165

5317. POLARIZATION OF X-RAY QUANTA AND NON-CONSERVATION OF PARITY IN K-CAPTURE. A.Z.Dolginov.
Nuclear Phys., Vol. 6, No. 3, 460-3 (April [1], 1958).

The effect of parity non-conservation in β-interaction on the correlation between circular polarization of X-ray quanta emitted by an atom after K-capture and polarization of nuclear spins or of subsequent nuclear quanta is considered. L-capture is examined and it is shown that in capture from the L_{III} shell the angular distribution of X-ray quanta is anisotropic. A.

539.165.2

5318. ON THE POLARIZATION OF ELECTRONS IN β-DECAY. M.E.Vishnevsky, V.K.Grigoriev, V.A.Ergakov, S.J.Nikitin, E.V.Pushkin and Yu.V.Trebukhovsky.
Nuclear Phys., Vol. 4, No. 2, 271-2 (Aug. [2], 1957).

Electrostatic deflection and scattering in gold was used to study the longitudinal polarization of β-rays from Cu^{64} (v/c = 0.63). It was found that $\sigma.p$ is negative and the magnitude of asymmetry was consistent with the predictions of the two-component theory.

M.A.Grace

539.165.2 : 530.145

5319. PARITY VIOLATION IN β-DECAY: CORRELATION OF THE ELECTRON DIRECTION WITH THE POLARISATION OF A SUBSEQUENTLY EMITTED NEUTRON. G.A.Jones and F.Mandl.
Nuclear Phys., Vol. 4, No. 5, 690-2 (Nov., 1957).

Parity violation will produce observable effects in the case of delayed neutron emission; the delayed neutron will in general be polarized along the direction of the preceding electron, the degree of polarization being dependent on the direction of emission of the neutron relative to the electron. In the case considered the polarization is a maximum for neutrons emitted in a direction perpendicular to that of the electrons and is perpendicular to the direction of motion of the neutron, this being the most convenient for detection. In contrast, emission of γ-radiation following β-decay results only in circular polarization. Some details are given concerning a projected experiment to measure the polarization correlation in the decay of N^{17}. A.

539.165.2

5320. MANY BODY EFFECTS IN BETA-DECAY. J.S.Bell.
Nuclear Phys., Vol. 5, No. 1, 167-72 (Jan., 1958).

In mirror transitions involving nuclei with doubly closed cores plus or minus one particle the Gamow–Teller contribution appears to be smaller, by from 15% to 60%, than that predicted by the shell model. The effect of correlation in the nuclear wave-function, tentatively estimated by applying perturbation theory to a simple Fermi gas model, is found to be in the right direction but too small. A.

539.165.2

5321. A THEORETICAL BASIS FOR A POSSIBLE THEORY OF β-DECAY. J.C.Polkinghorne.
Nuclear Phys., Vol. 5, No. 1, 288-93 (Jan., 1958).

A theoretical basis is proposed for a β-decay interaction similar to that suggested by Arnowitt and Feldman. The theory would account for a zero-mass neutrino (though it is not a two-component theory) and negatron emission through S and T together with positron emission through A and V. It is based on a possible theory of the source of the masses of the elementary particles. An explanation is offered of the anomalous muon mass. A.

539.165.2

5322. COULOMB CORRECTIONS TO THE FERMI NUCLEAR MATRIX ELEMENT. W.M.MacDonald.
Phys. Rev., Vol. 110, No. 6, 1420-7 (June 15, 1958).

The Fermi nuclear matrix elements for positron decay between two T = 1 states can be evaluated exactly for charge-independent nuclear forces in the limit of nonrelativistic nucleon velocities to give $M_F = \sqrt{2}$. Sherr and Gerhart have used this fact to place limits on the Fierz interference terms for the scalar and vector β-interactions by comparing the ft values for the O^{14}, Al^{26}, and Cl^{34} $0^+ \rightarrow 0^+$ β-decays. The equality of these ft values to within an experimental uncertainty of ~ 10% implies a limit for the contribution of the Fierz interference term to the ft value of 12%. Such a limit will be modified by the correction terms arising from the Coulomb interaction and from v^2/c^2 terms in the nucleon velocities. These Coulomb correction terms are calculated on the coupling model with harmonic-oscillator wave-functions and are shown to affect the ratio of the ft values for Cl^{34} and O^{14} by less than 1.5%. The relativistic corrections to the ratio have been shown to be even smaller. Therefore the uncertainty in the theoretical value for the square of the Fermi nuclear matrix elements is much smaller than the present experimental uncertainty in the ft values. A.

539.165.2

5323. THE INFLUENCE OF THE PSEUDOSCALAR INTERACTION IN THE DECAY OF Pr^{144}. G.Alaga, L.Šips and D.Tadić.
Period. math.-phys. astron. (Zagreb), Vol. 12, No. 3, 207-16 (1957).

The β-ray spectral distribution of the $0^- - 0^+$ ground state transition is interpreted as being due to a mixture of pseudoscalar and tensor interactions with the pseudoscalar coupling constant and the corresponding matrix element being dominant. M.A.Grace

539.165.2 : 539.12 : 530.145

CONSERVATION LAWS FOR μ-DECAY. See Abstr. 4714

539.166

5324. NEUTRON CAPTURE GAMMA RAYS FROM LITHIUM, BORON, AND NITROGEN. G.A.Bartholomew and P.J.Campion.
Canad. J. Phys., Vol. 35, No. 12, 1347-60 (Dec., 1957).

In Li^7 γ-rays are observed at 7.26 ± 0,03 MeV and 6.78 ± 0.05 MeV. In B^{11} six γ-rays are detected. The spectrum is consistent with J = 7/2+ for the capturing state. In N^{15} six previously unreported γ-rays are detected. Estimates of thermal neutron radiative capture cross-sections are: Li^6, 0.028 ± 0.008 b.; B^{10}, 0.5 ± 0.2 b.; and N^{14}, 0.08 ± 0.02 b. A.

539.166

5325. NEUTRON CAPTURE GAMMA RAYS FROM FLUORINE, MAGNESIUM, GALLIUM, BROMINE, AND HAFNIUM.
P.J.Campion and G.A.Bartholomew.
Canad. J. Phys., Vol. 35, No. 12, 1361-79 (Dec., 1957).

The neutron capture γ-ray spectra were studied in the energy range above 3 MeV. In fluorine four γ-rays and in magnesium 12 γ-rays were detected in addition to those previously observed. Most of these new radiations can be assigned to the known level schemes of the product nuclei. The spectrum obtained for each of the other elements is complex with only a few of the high energy γ-rays resolved, and in each case the γ-ray of highest energy is very weak and difficult to distinguish from the background. The most energetic gallium γ-ray at 7.73 ± 0.02 MeV may be emitted in the direct ground state transition in Ga^{70} while the 7.879 ± 0.013 MeV γ-ray from bromine probably corresponds to the ground state transition in Br^{80}. In hafnium none of the observed γ-rays can be identified with a ground state transition in any of the isotopes. A.

539.166

5326. REVISION OF $^{212}_{83}Bi$ γ-SPECTRUM BY MEANS OF THE $\gamma-\alpha$ COINCIDENCES. B.Chinaglia and F.Demichelis.
Nuovo Cimento, Vol. 8, No. 3, 365-8 (May 1, 1958).

The fast–slow coincidences between Bi^{212} γ-rays and Po^{212} α-particles allow a separation of γ-rays from those emitted by the other nuclides in equilibrium in the Th^{228} source. This method can be applied on account of the shortness of the half-life of Po^{212}. From the results some γ-rays uncertain in previous experimental researches can be assigned to Bi^{212}. A decay scheme is proposed. A.

539.166

5327. GAMMA–GAMMA ANGULAR CORRELATIONS WITH CIRCULAR POLARIZATION MEASUREMENTS. E.G.Beltrametti. Nuovo Cimento, Vol. 8, No. 3, 445-50 (May 1, 1958).

The problem of γ–γ double angular correlation is examined in which circular polarization of the photons is observed. The relation among the various possible correlations is discussed. The Legendre polynomials of odd order introduce an asymmetry around the value $\beta = \pi/2$, where β is the angle between the two radiations. Numerical calculations are made for the γ–γ cascade of Co^{60}. A.

539.166

5328. ROTATIONAL SPECTRUM OF Tm^{171}. E.N.Hatch and F.Boehm. Phys. Rev., Vol. 108, No. 1, 113-15 (Oct. 1, 1957).

The gamma-rays emitted from Tm^{171} following the Er^{171} beta decay were measured with the two-metre curved-crystal spectrometer and a semicircular beta-ray spectrometer, enabling a comparison of the nuclear levels and rotational parameters for the Tm^{171} ground-state band with the corresponding levels and parameters of Tm^{169}. The measured gamma-rays have the following energies in keV: 5.06 ± 0.05, 12.40 ± 0.05, 111.63 ± 0.02, 116.69 ± 0.03, 124.03 ± 0.03, 210.62 ± 0.15, 284.9 ± 0.7, 295.97 ± 0.15, 308.37 ± 0.15. In comparing the rotational parameters, a slight increase in the deformation of Tm^{171} over that of Tm^{169} is noted. The relatively large change in the decoupling parameter (a = −0.8563) for Tm^{171} compared with that of Tm^{169} cannot be accounted for entirely by the small change in nuclear deformation. A.

539.166.08

5329. A COMPTON SPECTROMETER WITH PULSE ADDITION. V.R.Burmistrov and Yu.A.Kazanskiĭ. Priborȳ i tekh. Éksper., 1957, No. 2, 26-9. In Russian.

A scintillation Compton γ-spectrometer is described which is based on the principle of addition of the pulses corresponding to the energy of a recoil electron in the central crystal and to the energy of a scattered photon falling into the controlling crystal. Such addition of the pulses permits an increase in the effectiveness of the spectrometer of an order greater than that with the usual Compton spectrometer. Also the resolution is improved, and approximates to the resolution on a photo-peak in a single crystal spectrometer. P.Collins

539.166.2

5330. NUCLEAR RESONANCE FLUORESCENCE IN SOME HEAVY NUCLEI. F.R.Metzger. J. Franklin Inst., Vol. 261, No. 2, 219-36 (Feb., 1956).

Using the Doppler broadening due to thermal agitation and the Doppler shift due to mechanical motion as means of restoring the resonance condition, nuclear resonance fluoresence was observed from the following isotopes: Pr^{141} (145 keV), Hg^{198} (411 keV), Hg^{199} (209 keV), Hg^{202} (439 keV) and Tl^{203} (280 keV). From the magnitude of the resonance fluorescence effects the following mean lives of the gamma-ray transitions were calculated: $(3.0 \pm 0.4) \times 10^{-9}$, $(3.15 \pm 0.3) \times 10^{-11}$, $(1.2 \pm 0.4) \times 10^{-10}$, $(3.4 \pm 0.7) \times 10^{-11}$, $(4.7 \pm 0.8) \times 10^{-10}$ sec. For the even–even nuclei, the angular distribution of the resonance radiation confirmed spin 2 for the excited state, and spin 0 for the ground state. A.

539.166.2 : 539.14

5331. A FURTHER STUDY OF THE DECAY OF Ir^{192}. J.Mráz. Nuclear Phys., Vol. 4, No. 3, 457-62 (Sept., 1957).

The angular correlations of 308-316, 308-296 and 296-316 keV gamma cascades in the radiations of Pt^{192} were measured to remove the ambiguities in the spin assigned to the fourth excited level of Pt^{192}. An interpretation of the excited levels of Pt^{192} is given. A.

539.166.2 : 539.14

5332. ANGULAR CORRELATIONS OF GAMMA RAY CASCADES FOLLOWING THE DECAY OF Eu^{152}. S.Ofer. Nuclear Phys., Vol. 4, No. 3, 477-87 (Sept., 1957).

The angular correlations of five γ-ray cascades following the decay of Eu^{152} to Sm^{152} and to Gd^{152} were measured. From these measurements, assignments for the spins of excited levels and multipolarities of the γ-radiations are made. The results strongly support the suggestion that the 1082 keV and 1226 keV levels of Sm^{152} should be interpreted as collective vibrational levels. A.

539.166.2 : 539.17

5333. THE ANGULAR γ–γ CORRELATION IN THE $N^{14}(p,\gamma)O^{15}$ REACTION. S.Gorodetzky, A.Gallmann, M.Croissiaux and R.Armbruster. Nuclear Phys., Vol. 6, No. 3, 517-24 (April [1], 1958). In French.

The authors measured, in two different planes, the γ–γ angular correlation in the cascade 8.34 MeV → 5.27 MeV → 0 of O^{15} through the $N^{14}(p,\gamma)O^{15}$ reaction, at its resonance at 1.060 MeV. The experimental results agree with the value J = 3/2 for the angular momentum of the 5.27 MeV level. The computations made do not allow exclusion of the value J = 5/2+. A.

539.166.83

5334. CONVERSION SPECTRUM OF Ho^{160}. E.P.Grigor'ev, B.S.Dzhelepov, A.V.Zolotavin, B.Kratsik, B.K.Preobrazhenskiĭ and I.S.Yanchevskaya. Dokl. Akad. Nauk SSSR, Vol. 117, No. 1, 53-6 (1957). In Russian.

The conversion spectrum arising in the transition $Er^{160} \rightarrow Ho^{160} \rightarrow Dy^{160}$ was measured by a high-resolution, double-focusing β-ray spectrometer. From this, the decay scheme of Ho^{160} was constructed. G.E.Brown

NUCLEAR REACTIONS

539.17 : 536.7

5335. COMPOUND NUCLEUS FORMATION AS AN IRREVERSIBLE THERMODYNAMICAL PROCESS. C.E.Porter. Nuclear Phys., Vol. 4, No. 3, 472-6 (Sept., 1957).

It is emphasized that in the energy region where the level widths are much smaller than the spacings between levels, compound nucleus formation is appropriately characterized as an irreversible thermodynamical process and that therefore there is an analogue of the Nyquist formula in which the strength function plays the role of the customary admittance factor. A.

539.17

5336. A UNIFIED FORMULATION OF THE THEORY OF NUCLEAR REACTIONS. C.Bloch. Nuclear Phys., Vol. 4, No. 4, 503-28 (Oct., 1957). In French.

The determination of the scattering matrix in the theory of nuclear reactions is essentially equivalent to the construction of the Green function for the Schrödinger equation in the internal region of the configuration space with proper boundary conditions at the nuclear surface. This Green function can be expressed as the inverse of an operator involving the sum of the Hamiltonian and of a "boundary value operator" which is different from zero only on the nuclear surface where it has a singularity of the same kind as a Dirac function. A general operator expression for the scattering matrix is derived. This expression can be transformed into a matrix expression by introducing an arbitrary basis of orthonormal functions in the internal region. The Wigner–Eisenbud and the Peierls–Kapur formulations are obtained by an appropriate choice of the internal functions. When a large number of resonances contribute to the cross-section, the expansion of the scattering matrix in terms of resonances of the compound system is not useful, and a more appropriate starting point can be obtained from a perturbation expansion of the scattering matrix which is easily derived from the general operator expression. A simple statistical assumption is proposed in order to determine the dominant terms in such an expansion. It leads to the optical model for the elastic scattering and to the direct interactions for the inelastic scattering. A.

539.17

5337. TIME REVERSAL AND THE RELATION BETWEEN ANGULAR DISTRIBUTIONS OF ABSORPTION AND EMISSION PROCESSES. R.Huby. Proc. Phys. Soc., Vol. 72, Pt 1, 97-102 (July, 1958).

A simple rule is given for modifying the formula for the angular distribution of any nuclear process, however complicated, which involves absorption of a particle (or radiation) p in the transition stage $p + A \rightarrow B$ so as to yield the angular distribution of the process which differs only in the replacement of the absorption stage by an emission stage $A \rightarrow p + B$. The time-reversal operation is involved, and one is led to the time reversal of density and efficiency matrices, and of statistical and efficiency tensors. A.

539.17

5338. CHARGE INVARIANCE IN NUCLEAR REACTIONS. A.I.Baz'. Zh. éksper. teor. Fiz., Vol. 32, No. 3, 478-90 (1957). In Russian English translation in: Soviet Physics — JETP (New York), Vol 5, No. 3, 403-12 (Oct., 1957).

It is shown that there exists a relation between the cross-sections of the reactions $He^3(p,p)He^3$, $He^3(n,n)He^3$, $He^3(n,p)T$; $T(p,n)He^3$; $T(p,p)T$. This relation is based on the hypothesis of charge invariance of nuclear forces; because of it the num-

ber of independent parameters (phases) necessary for a complete description of these reactions can be reduced. The cross-sections of these reactions are all expressed by the same parameters $\delta(T)$ and $\epsilon(T)$ [the phases and mixture parameters in a state with isotopic spin T] and thus it is possible to carry out a phase analysis of all these reactions simultaneously. The method applied is a general one and it is applicable, with only slight changes, to all reactions involving light nuclei. A.

539.17 : 539.12

5339. ON THE ABSORPTION OF HIGH-ENERGY NUCLEAR-ACTIVE PARTICLES. S.Z.Belen'kiĭ and N.M.Gerasimova.
Zh. éksper. teor. Fiz., Vol. 32, No. 3, 547-51 (1957). In Russian. English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 3, 456-9 (Oct., 1957).

The process of multiple particle production occurs in nuclear collisions in the high-energy region ($\sim 10^{12}$ eV and higher). The secondary particles of high enough energy can, in their collision with the nuclei of the matter, lead to additional multiple production (such particles are called nuclear-active). In this fashion not only absorption, but also multiplication, of the nuclear-active particles occurs as they propagate through matter. The propagation of nuclear-active particles in matter is computed from the cross-sections for the elementary collision act, obtained on the basis of the hydrodynamic theory of multiple particle production. A.

539.17 : 530.145

TIME REVERSAL AND REACTIONS INVOLVING POLARIZED PARTICLES. See Abstr. 4716

539.17 : 539.12

SCATTERING CROSS-SECTION NEAR THE REACTION THRESHOLD. See Abstr. 5175

539.17

NUCLEAR REACTIONS DUE TO COSMIC RAYS. See also under "Cosmic rays". Decimal classification 537.591.8

539.17

5340. EXTRANUCLEAR EFFECTS WITH FAST RECOILING NUCLEI. P.B.Treacy.
Austral. J. Phys., Vol. 10, No. 3, 373-7 (Sept., 1957).

Experimental results are given on angular distributions in the reaction $F^{19}(p,p'\gamma)$ proceeding, via the second excited state of F^{19}, with targets in different physical and chemical states. It is noted that effects of extranuclear interactions in flight, in solid or liquid media, should be negligible. Tentative information is obtained about the fate of recoil nuclei in the solids NaF and CaF_2. The interpretation is consistent with some effects observed in $\alpha-\gamma$ angular correlations from Am^{241} in solid sources. A.

539.17 : 539.14

5341. INELASTIC SCATTERING OF 185 MeV PROTONS ON OXYGEN, CALCIUM AND CARBON. H.Tyrén and T.A.J.Maris.
Nuclear Phys., Vol. 4, No. 5, 637-42 (Nov., 1957).

The energy spectra at various angles for the inelastic scattering of protons near 180 MeV on oxygen, calcium and carbon were measured with a magnetic analyser. Maxima corresponding to excited states of the target nuclei were resolved and some differential and total cross-sections are reported. A.

539.17

5342. SOME REMARKS CONCERNING MEASURMENTS ON INELASTIC SCATTERING OF 155-185 MeV PROTONS ON CARBON, OXYGEN AND CALCIUM. T.A.J.Maris and H.Tyrén.
Nuclear Phys., Vol. 4, No. 5, 662-71 (Nov., 1957).

Semi-quantitative theoretical expectations for the differential cross-sections of high-energy inelastic proton scattering are summarized and compared with the experimental results for carbon, oxygen and calcium. The general agreement is satisfactory. High-energy proton scattering at small angles seems a promising tool for the study of the giant gamma-resonances at least in light nuclei. Some remarks concerning the measured asymmetries and polarizations of the inelastically scattered protons are made. A.

539.17

5343. THE ASYMMETRY OF 155 MeV PROTONS ELASTICALLY AND INELASTICALLY SCATTERED FROM CARBON, OXYGEN, AND CALCIUM. R.Alphonce, A.Johansson and G.Tibell.
Nuclear Phys., Vol. 4, No. 5, 672-6 (Nov., 1957).

The asymmetry of protons scattered elastically and inelastically from oxygen and calcium has been studied with the conventional double-scattering technique using range telescopes. Results are given for the asymmetry in scattering from oxygen and calcium together with improved values of previously reported carbon data. The angular distributions of the elastic asymmetry are quite similar for the three elements. For the inelastic asymmetry of oxygen and calcium it has been possible to obtain only qualitative results. A.

539.17

5344. INELASTIC SCATTERING OF 185 MeV PROTONS ON NUCLEI WITH MASSES FROM FLUORINE TO POTASSIUM. H.Tyrén and T.A.J.Maris.
Nuclear Phys., Vol. 6, No. 3, 446-50 (April [1], 1958).

Inelastic spectra of 185 MeV protons scattered at two different angles on nuclei from fluorine to potassium are reported. A.

539.17

5345. THE INELASTIC SCATTERING OF PROTONS BY C^{12}. E.J.Squires.
Nuclear Phys., Vol. 6, No. 3, 504-16 (April [1], 1958).

The differential cross-section and polarization for the inelastic scattering of 180 MeV protons by C^{12} leaving the nucleus in the 4.43 MeV state are calculated, using shell-model wave-functions in the L—S and j—j coupling extremes and nucleon—nucleon phase shifts taken from an analysis of free nucleon—nucleon scattering, and taking the absorption part of the optical model potential into account. Good agreement is found when L—S coupling is used, especially when use is made of information obtained from inelastic electron scattering to obtain a correction to the nuclear matrix elements calculated with the crude shell-model wave-functions. Some discussion is given of the difference between polarization and asymmetry in inelastic scattering and it is shown that this difference is likely to be small. A.

539.17 : 539.14

5346. QUASI-ELASTIC SCATTERING AND NUCLEAR STRUCTURE. T.A.J.Maris, P.Hillman and H.Tyrén.
Nuclear Phys., Vol. 7, No. 1, 1-9 (June [1], 1958).

Energy and angular correlation measurements on the two protons emerging from high energy (p, 2p) processes may give direct information on the structure of the ground state of the bombarded nucleus and of certain excited states of the residual one. Expectations are derived on the basis of the assumptions of the approximative validity of the shell model and the Serber—Chew hypothesis of the reaction mechanism. The influence of multiple collisions in the nucleus is considered. A.

539.17 : 539.14

5347. HIGH ENERGY (p, 2p) REACTIONS AND PROTON BINDING ENERGIES. H.Tyrén, P.Hillman and T.A.J.Maris.
Nuclear Phys., Vol. 7, No. 1, 10-23 (June [1], 1958).

The energy carried away by each of the two coincident protons from (p, 2p) reactions in elements bombarded by 185 MeV protons has been measured by range analysis. To the extent that the collisionsis quasi-elastic, the difference between the sum of these energies and the incident energy, corrected for the recoil energy of the residual nucleus, gives the binding energy of the struck proton in the nucleus. Sharp groups which can be associated with the nuclear shell structure have been observed in the light elements. The results determine directly the spin—orbit splitting in the 1p-shell and the binding energy of the 1s-shell for the lightest nuclei. Only the spectrum of Be^9 might give some indication of an α-particle structure. A.

539.17 : 539.12

5348. INELASTIC SCATTERING OF PROTONS AT INTERMEDIATE ENERGIES. N.Oda and K.Harada.
Nuclear Phys., Vol. 7, No. 3, 251-62 (June [3], 1958).

The differential cross-sections for the inelastic scattering of protons at intermediate energies are calculated in an analytical way on the basis of the statistical independent particle model with a diffuse nuclear surface, assuming that the main contribution to the cross-section comes from the direct interactions of incident protons with the target nucleons penetrating out beyond some critical radius in the diffuse rim of the nucleus, and taking the Pauli principle exactly into consideration. The contribution of the compound nucleus formation process to the cross-section was also estimated. The application to the inelastic scattering of 31 MeV protons by Sn leads to values of the cross-sections in good agreement with the experiment. A.

539.17 : 539.14

5349. REFRACTION EFFECTS IN DIRECT NUCLEAR REACTIONS. N.Austern and S.T.Butler.
Phys. Rev., Vol. 109, No. 4, 1402-3 (Feb. 15, 1958).

Levinson and Banerjee have shown (Abstr. 1945-6/1958) that

the peaking of the angular distribution at small angles for $C^{12}(p,p')C^{12*}$ (Q = 4.4 MeV, angular momentum transfer l = 2) can be explained by using the direct interaction mechanism with distorted wave-functions for the proton. A semi-classical description of this distortion is given here by the refraction of the ray representing the trajectory at the surface of the optical potential. Small momentum transfer can then contribute for $l \neq 0$. Noting that most of the refracted rays in this case have had to pass through the deep interior of the nucleus, one can conclude that the study of such peaks for light nuclei will yield detailed information about the imaginary part of the potential. J.Lascoux

539.17

5350. RESONANT ABSORPTION OF GAMMA RAYS. S.S.Hanna and L.Meyer-Schützmeister. Phys. Rev., Vol. 108, No. 6, 1644-5 (Dec. 15, 1957).

A C^{13} target was irradiated with protons, exciting the 1.76 MeV resonance in the reaction $C^{13}(p,\gamma)N^{14}$. The variation of γ-ray energy with angle of observation was used to obtain resonant absorption measurements for the reaction $N^{14} + \gamma \rightarrow N^{14*}$ by interposing a quantity of liquid nitrogen between the target and the γ-ray detector, which consisted of a NaI crystal and photomultiplier coupled to a 10-channel pulse-height analyser. The angle of observation with respect to the incident proton beam was defined by a slit system of known angular width and was varied between 79^0 and 82^0. From the resonant absorption curves the intrinsic width of the 9.18 MeV level in N^{14} was measured as 0.35 ± 0.1 keV. The total resonant absorption cross-section (σ_R) was deduced to be 0.79 ± 0.10 barn, and the cross-section for the radioactive capture process $\sigma_R(p,\gamma)$ 33 mb. This latter value should be increased by 10% to include transition to the 6.44 MeV excited state. D.R.Chick

539.17

5351. RESONANT ABSORPTION OF GAMMA RADIATION FROM THE $Al^{27}(p,\gamma)Si^{28}$ REACTION. P.B.Smith and P.M.Endt. Phys. Rev., Vol. 110, No. 2, 397-402 (April 15, 1958).

Gamma-rays emitted by excited Si^{28} formed in the reaction $Al^{27}(p,\gamma)Si^{28}$ at E_p = 771 keV were selectively absorbed in silicon. Selective, or resonant, absorption occurs when the absorber is placed at such an angle that the loss of energy upon emission and reabsorption of the photons is restored by the Doppler shift resulting from the forward motion of the excited Si^{28} nucleus. A narrow slit in a lead collimator is filled with silicon powder, and the transmitted gamma-radiation is detected by a scintillation counter. The absorption dip observed as the collimator is rotated through the resonant angle has a width (determined primarily by the width of the collimator slit) of 0.75 degree, the maximum absorption amounting to 21%. From the integral of the absorption as a function of angle, and from an absolute measurement of the (p,γ) integral cross-section, the radiation width for transition to the ground state (E_γ = 12.33 MeV) is determined to be 5.2 ± 0.5 eV, while 2.0 ± 0.5 eV is found for the proton width, and 9.0 ± 0.8 eV for the total width. The half-life calculated from the latter is $(4.5 \pm 0.4) \times 10^{-17}$ sec. These values, together with the angular distribution of the ground-state radiation, measured by Gove et al. are consistent with a 1^+ assignment to the resonance level. A.

539.17

5352. RESONANT ABSORPTION OF GAMMA RADIATION FROM THE $Si^{30}(p,\gamma)P^{31}$ REACTION. P.B.Smith and P.M.Endt. Phys. Rev., Vol. 110, No. 6, 1442-5 (June 15, 1958).

The technique of collision-produced Doppler shift was used to induce resonant absorption. The gamma-rays emitted by excited P^{31} from the $Si^{30}(p,\gamma)P^{31}$ reaction at E_p = 662 keV were selectively absorbed in phosphorus. Resonant absorption of the 7.90 MeV gamma-rays emitted from this level occurs at 76.6 degrees with respect to the proton beam direction. Since the experimental absorption curve is broader than the previously measured instrumental resolution curve, it has been possible to determine directly the total width of the resonance level as 40 ± 7 eV. From the absorption integral, together with this value of the total width, the radiation width for transitions to the ground state is found to be 1.52 ± 0.12 eV. A $\frac{1}{2}^+$ spin assignment is made on the basis of the partial widths thus obtained. A.

539.17

5353. NEUTRON SPECTRUM FROM p+d REACTION. M.P.Nakada, J.D.Anderson, C.C.Gardner, J.McClure and C.Wong. Phys. Rev., Vol. 110, No. 2, 594-5 (April 15, 1958).

The time-of-flight neutron spectrum from 8.9 MeV protons on deuterium shows, in addition to the expected continuum, a real peak at about 6 MeV evident at small angles. This is explicable qualitatively by assuming direct interaction between the incident proton and the neutron of the deuteron, and considering the interaction of the recoiling proton with the other proton, using p–p scattering data. A.E.I. Research Laboratory

539.17 : 539.12

5354. POLARIZATION OF NUCLEONS ELASTICALLY SCATTERED BY NUCLEI. K.Nishimura. Phys. Rev., Vol. 110, No. 5, 1166-8 (June 1, 1958).

The polarization of 424 MeV nucleons elastically scattered by nuclei is calculated by a method which is similar to the Born approximation, but in which the phase shifts of the incident plane wave due to the scattering potential is taken into consideration. A qualitative agreement with the experimental result is obtained if one uses the well parameters determined by Riesenfeld and Watson (Abstr. 6151 / 1956). Poor agreement at the diffraction minimum may be attributed to the existence of inelastic scattering in the experimental data. A.

539.17

5355. (p,pn) AND (p,2p) REACTIONS OF Ce^{140} AT PROTON ENERGIES FROM 0.4 TO 3.0 BeV. A.A.Caretto and G.Friedlander. Phys. Rev., Vol. 110, No. 5, 1169-73 (June 1, 1958).

Cross-sections are reported for these reactions of Ce^{140} with protons of 0.4, 1.0, 2.2, and 3.0 BeV. To evaluate the contribution of proton and neutron evaporation from excited Ce^{140} nuclei to the observed cross-sections, this evaporation competition was studied by means of cross-section measurements on the reactions $Ba^{138}(\alpha,n)$ and $Ba^{138}(\alpha,p)$ with α-particles of 19 to 40 MeV kinetic energy. The ratio $\sigma_{\alpha,n}/\sigma_{\alpha,p}$ is between 2.4 and 4.4 in this region as compared with a ratio of 1.58 ± 0.14 for $\sigma_{p,pn}/\sigma_{p,2p}$ at 0.4 BeV. It is concluded that at this energy the (p,pn) and (p,2p) reactions proceed at least partially by a pure knock-on mechanism. This conclusion is supported by comparison of the data with recent Monte Carlo calculations of intranuclear cascades. With increasing proton energy both $\sigma_{p,2p}$ and $\sigma_{p,pn}$ are found to decrease, the former more rapidly than the latter. This energy dependence is discussed in terms of the elementary nucleon–nucleon cross-sections. The Monte Carlo calculations agree within their rather poor statistical accuracy with the measured cross-section ratios and with the energy dependence of the cross-sections, but predict cross-section values about a factor of three too small. A.

539.17 : 539.12

π^0-MESON PRODUCTION IN p–p AND p–n COLLISIONS. See Abstr. 5235

539.17 : 539.166.2

ANGULAR γ–γ CORRELATION IN THE $N^{14}(p,\gamma)O^{15}$ REACTION. See Abstr. 5333

539.17

5356. COULOMB EXCITATION CROSS SECTIONS OF GADOLINIUM ISOTOPES FROM INELASTIC SCATTERING MEASUREMENTS. V.Ramšak, M.C.Olesen and B.Elbek. Nuclear Phys., Vol. 6, No. 3, 451-9 (April [1], 1958).

The cross-sections for Coulomb excitation and the energies of the accessible low-lying rotational states in the six most abundant isotopes of gadolinium ($Gd^{154-8,\ 160}$) were determined from measurements on the corresponding groups of inelastically scattered protons and deuterons. The projectiles were accelerated in an electrostatic generator to energies around 4 MeV. Particles scattered from isotopically pure targets prepared in an isotope separator were observed at an angle of 145^0 with respect to the beam by means of a magnetic spectrometer of high resolution. The lifetimes for the first excited states in Gd^{154} and Gd^{156} derived from the measured cross-sections are in good agreement with the reported directly-measured lifetimes of these states. A.

539.17

5357. NEUTRONS FROM DEUTERON BOMBARDMENT OF BORON. J.R.Bird and R.H.Spear. Austral. J. Phys., Vol. 10, No. 2, 268-75 (June, 1957).

A natural boron target was bombarded by 920 keV deuterons, and the emitted neutrons detected using nuclear emulsions. A new procedure for analysing measurements is described, which allows approximate corrections for errors in geometry in the plane of the emulsions. The dependence of resolution on various experimental factors was studied, and the resolution achieved is indicated by peak widths of 245 ± 25 keV and 360 ± 50 keV at neutron energies of 9.7 MeV and 13.9 MeV, respectively. The angular distributions of the neutrons from the $B^{10}(d,n)C^{11}$ reaction corresponding to the ground state of C^{11}, and the neutrons from the $B^{11}(d,n)C^{12}$ reaction

rresponding to the 7.66 MeV state in C^{12}, were determined; both stributions may be attributed to compound nucleus formation. search was made for a neutron group corresponding to an cited state at about 5.5 MeV in C^{12} suggested by Glassgold and alonsky (Abstr. 7621/1956) on the basis of the α-particle model. n upper limit for the intensity of any such group is set at 1% of the tensity of the group corresponding to the first excited state in C^{12}. A.

539.17

58. ON THE EXISTENCE OF LARGE INTENSITY ODULATIONS IN THE SPECTRA OF PROTONS FROM SOME UCLEAR REACTIONS. L.Colli and S.Micheletti. uovo Cimento, Vol. 6, No. 4, 1001-5 (Oct., 1957).

A magnetic spectrograph of high resolution was used to mease the energy of proton groups from two (d,p) reactions and from e inelastic scattering of protons from copper. Large numbers of ell-defined groups, corresponding to residual nuclear excitations up to 8 MeV were found. There was shown to be a regular varia-on in the mean intensity of these groups, corresponding to a modu-tion with period about 1 MeV. Previous work with low-resolution uipment shows only the modulation envelope, as a regular series broad peaks. J.H.Fremlin

539.17 : 539.14

359. INELASTIC DEUTERON SCATTERING FROM HROMIUM AND COBALT. F.A.El Bedewi and S.Tadros. uclear Phys., Vol. 6, No. 3, 434-9 (April [1], 1958).

A magnetic spectrograph with photographic detection is used study the angular distribution of some deuteron groups inelastic-ily scattered from chromium and cobalt. The incident deuterons ave an energy of about 8.7 MeV. An observed level in Cr^{52} at .44 ± 0.02 MeV was found to have spin 2^+ supporting the recent eoretical prediction of Lawson and Uretsky (Abstr. 9329/1957). hree levels in Co^{59} at 1.27 MeV, 1.54 MeV and 1.75 MeV, with rors of 0.02 MeV, were observed. The angular momentum transrred to this nucleus at the 1.27 MeV level is found to be 2 units. A.

539.17

360. REACTION $Li^6(d,t)Li^5(p)He^4$. R.T.Frost and S.S.Hanna. hys. Rev., Vol. 110, No. 4, 939-40 (May 15, 1958).

A study is made of the proton and triton continua from the euteron bombardment of Li^6 in order to obtain information on the echanism of the three-particle reaction and on the properties of e ground state of Li^5. Because of the great breadth of this state, unambiguous interpretation is not possible. The most likely echanism is $Li^6(d,t)Li^5(p)He^4$, with a Q = 0.80 ± 0.15 MeV for the imary reaction (mass defect of Li^5 = 12.95 ± 0.15 MeV), and a idth of the ground state of Li^5 equal to 2.0 ± 0.2 MeV (in the c.m. stem). A.

539.17 : 539.12

361. THE POLARIZATION OF PROTONS FROM THE Cd(d,p)^{13}C REACTION. .S.Bokhari, J.A.Cookson, B.Hird and B.Weesakul. roc. Phys. Soc., Vol. 72, Pt 1, 88-96 (July, 1958).

The polarization of the ground-state protons emitted when C^{12} bombarded with 8.9 MeV deuterons was measured at several gles. These results were compared with recent calculations of ewns and Refai. The angular distribution of the polarization was und to have the predicted shape but its sign and magnitude suggest improbable proton—nucleus interaction. A.

539.17

362. ENERGY AND ANGULAR DISTRIBUTION OF NEUTRONS MITTED IN THE $Be^9(d,n)B^{10}$ REACTION. A.I.Shpetnyĭ. h. éksper. teor. Fiz., Vol. 32, No. 3, 423-31 (1957). In Russian. nglish translation in: Soviet Physics — JETP (New York), Vol. 5, o. 3, 357-64 (Oct., 1957).

The energy spectra and angular distributions of neutrons from e $Be^9(d,n)B^{10}$ reaction were investigated at deuteron energies of 5, 0.8, 1.0, 1.2, 1.4 and 1.6 MeV. The excitation curve for this eaction indicates a resonance at 1 MeV in the compound nucleus, ^{11}. The angular distribution corresponding to an excited state in ^{10} with excitation energy E_x = 3.62 MeV points to the existence of a ripping mechanism. The angular distributions of reactions involvg the formation of compound nuclei are appreciably distorted on assage through a resonance. A.

539.17 : 539.12

5363. DIFFRACTION SCATTERING OF FAST DEUTERONS BY NUCLEI. A.I.Akhiezer and A.G.Sitenko. Zh. éksper. teor. Fiz., Vol. 32, No. 4, 794-805 (1957). In Russian. English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 4, 652-60 (Nov., 1957).

The cross-section for elastic scattering and the cross-section for diffraction splitting of fast deuterons by completely black nuclei are determined. The energy distribution of the disintegration products is found. The cross-section for splitting of a fast deuteron by a completely black nucleus is calculated, taking the diffraction and Coulomb interactions into account. Expressions are obtained for the cross-sections for elastic deuteron scattering and splitting, taking into account the semi-transparency of the nucleus. A.

539.17

5364. ELASTIC AND INELASTIC SCATTERING OF 18 MeV ALPHA PARTICLES FROM NEON, ARGON, AND XENON. L.Seidlitz, E.Bleuler and D.J.Tendam. Phys. Rev., Vol. 110, No. 3, 682-91 (May 1, 1958).

The scattering was studied with a multiplate reaction chamber. The scattered particles were defined within an r.m.s. angular width of 0.45° by a system of slit pairs, spaced every $2\frac{1}{2}$° from 10° to 170°. The elastic scattering from neon and argon show the pronounced maxima and minima characteristic of diffraction scattering but are equidistant in ϕ, not $\sin(\phi/2)$. The ratio to Rutherford scattering varies as much as 25-fold between successive maxima and minima in the case of neon, the well-defined structure indicating a small mean free path for absorption of alpha-particles in the nucleus. Nuclear interaction radii calculated by the formula $2kR\Delta[\sin(\phi/2)] = \pi$ were found to be 6.36×10^{-13} cm for neon and 6.95×10^{-13} cm for argon. Xenon, investigated chiefly for control purposes, showed no definite deviation from Rutherford scattering up to 50°. Groups corresponding to the excitation of the 1.63, 4.25, 4.97, 5.81(5.63), and 7.2 MeV levels of Ne^{20} and the 1.46 MeV level of A^{40} were observed. No excited states were observed in xenon. Notably absent was excitation of the 6.74 MeV (0^+) level in Ne^{20}. As predicted by direct-interaction theories, the cross-sections for inelastic scattering leading to the first excited (2^+) states of neon and argon could be approximated by the squares of spherical Bessel functions of the second order with interaction radii of 6.71×10^{-13} cm for neon and 6.60×10^{-13} cm for argon. These cross-sections do not tend toward small values in the forward direction, which is interpreted as evidence for distortion of the incident and scattered waves. No fit was possible for any of the other excited states. A.

539.17

5365. RADIATIVE CAPTURE OF ALPHA PARTICLES TO STATES OF O^{18} AND F^{18}. W.R.Phillips. Phys. Rev., Vol. 110, No. 6, 1408-13 (June 15, 1958).

The radiative capture of alpha-particles in N^{14} and C^{14} was studied for bombarding energies between 1.3 and 3.0 MeV. Four narrow resonances were observed in the reaction $N^{14}(\alpha,\gamma)F^{18}$, corresponding to levels in F^{18} at 5.50, 5.67, 6.24 and 6.65 MeV. Two narrow resonances were observed in the reaction $C^{14}(\alpha,\gamma)O^{18}$, corresponding to levels in O^{18} at 7.63 and 8.05 MeV. These two are 1^- states. The decay schemes of some of these levels were partly elucidated, and several partial radiative widths were measured. The decays studied gave information on the low-lying levels in F^{18} and O^{18}. A.

539.17 : 539.14

5366. THE COULOMB EXCITATION OF U^{233} AND Np^{237} AND A DISCUSSION OF THE ENERGY LEVELS OF U^{233}. J.O.Newton. Nuclear Phys., Vol. 5, No. 1, 218-34 (Jan., 1958).

Gamma-rays of energy 40.4 ± 0.2, 51.5 ± 0.5, and 92.3 ± 1 keV for U^{233} and 33.24 ± 0.2 and 42.57 ± 0.3 keV for Np^{237} were observed in the Coulomb excitation of these nuclei by helium ions; a xenon-filled proportional counter was used as detector. The gamma-rays are interpreted as arising from the decay of rotational states. From the absolute cross-sections and from the braching ratios of the gamma-rays from the second rotational states the reduced transition probabilities B_{E2} and intrinsic quadrupole moments Q_0 were estimated. Mean values of Q_0 of 13.7 and 9.0 barns were obtained for U^{233} and Np^{237} respectively. Possible assignments of single-particle states in a deformed potential to the ground state of Np^{237} and to the ground and excited states of U^{233} are discussed. A.

539.17

5367. ENERGY DISTRIBUTIONS OF PRODUCT PARTICLES FROM NITROGEN-INDUCED NUCLEAR REACTIONS ON BERYLLIUM. C.D.Goodman and J.L.Need.
Phys. Rev., Vol. 110, No. 3, 676-82 (May 1, 1958).

The energy distributions of protons, deuterons and alpha-particles from N^{14} bombardment of Be^9 were measured with a particle-selective counter. The apparatus is described. The results show approximate agreement with the simple statistical assumptions of continuum theory both in regard to the shapes of the spectra and to the relative yields of protons, deuterons, tritons and α-particles. Reasonable agreement with the level-density formula $\omega(E) = \exp\{2[a(E-b)]^{1/2}\}$ is possible with a = 1.1, b = 0 for F^{19}; a = 1.4, b = 0 for Ne^{21}; and a = 2.6, b = 4.9 for Ne^{22}. A.

539.17

5368. DISINTEGRATION OF LIGHT NUCLEI IN A COULOMB FIELD. V.I.Mamasakhlisov and G.A.Chilashvili.
Zh. éksper. teor. Fiz., Vol. 32, No. 4, 806-10 (1957). In Russian. English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 4, 661-4 (Nov., 1957).

General formulae for the effective cross-section for disintegration of light nuclei in a Coulomb fields are derived. The formulae obtained are applied to the cases of the Li^7 and O^{17} nuclei, where is is assumed that the former splits into an α-particle and a triton, and the latter into O^{16} and a neutron. A.

539.17

5369. EXCITATION OF THE GIANT RESONANCE BY ELECTRONS. M.Fabre de la Ripelle.
C.R. Acad. Sci. (Paris), Vol. 245, No. 23, 2025-8 (Dec. 4, 1957). In French.

Goldhaber–Teller description of a charged proton sphere oscillating relatively to the neutron sphere is used for the excitation of the giant resonance by high-energy electrons. The first Born-approximation matrix element is given, with a form factor for the charge distribution taken over from the elastic scattering electron–nucleus. J.Lascoux

539.17

5370. THE MULTIPOLARITY OF γ-RAY ABSORPTION IN $^{13}C(\gamma,3\alpha)$ REACTION PRODUCED BY (Li,p)γ-RAYS.
J.Muto, E.Takekoshi, T.Nakamura, A.Imamura and Y.Tsuneoka.
J. Phys. Soc. Japan, Vol. 12, No. 2, 109-113 (Feb., 1957).

The mechanism of the $C^{12}(\gamma,3\alpha)$ reaction for (Li,p)γ-rays is estimated from a study of 576 stars in nuclear emulsions. By analysis of the angular distributions and correlation of the α-particles, the multipolarity of the absorption process of (Li,p)γ-rays by the C^{12} nucleus can be explained by the mixture of two sorts of interaction E1 and E2. This result is consistent with Goward and Wilkins' conclusion, but the experimental data of the angular distribution of the first α-particles show significant forward asymmetry contrary to their backward asymmetry. A.

539.17

5371. PHOTOPRODUCTION PROCESSES AND DISPERSION RELATIONS. A.A.Logunov, A.N.Tavkhelidze and L.D.Solovyov.
Nuclear Phys., Vol. 4, No. 3, 427-52 (Sept., 1957).

Dispersion relations for photoproduction of π-mesons on nucleons are obtained. The role of "bound states" is discussed in connection with an analysis of the unobservable energy region. The matrix structure of the photoproduction amplitude is considered. The dispersion relations are presented in a form convenient for phase-shift analysis. A.

539.17 : 539.12

5372. PHOTOPRODUCTION OF MESONS ON NUCLEONS: PHASE SHIFT ANALYSIS AND DISPERSION RELATIONS. L.D.Solovyov.
Nuclear Phys., Vol. 5, No. 1, 256-70 (Jan., 1958).

A phase-shift analysis of the dispersion relations obtained earlier (see preceding abstract) for photoproduction of mesons is carried out. It is assumed that the integrals in the dispersion relations converge with sufficient rapidity. The dependence of the photoproduction amplitude on the spin and isobaric variables and also the relation between the photoproduction and scattering amplitudes which follows from the unitary condition are considered. The range of unobservable angles, $\cos\theta < -1$, in the dispersion relations is examined in the c.m.s. Phase-shift analysis of the photoproduction amplitude was investigated and dispersion relations for partial waves were obtained on the assumption of rapid convergence of the integrals. In this case the equations for S- and P-waves were completely determined in the first approximation differing from the static one (that is, to terms of the order of μ/m). A.

539.17

5373. NOTE ON THE (γ,d) REACTIONS: AN ADDENDUM. J.Sawicki and W.Czyż.
Nuclear Phys., Vol. 4, No. 5, 695 (Nov., 1957).

See Abstr. 3379 (1958). The authors re-calculate the ratio of the (γ,d) to (γ,p) cross-sections for $S^{32}(\gamma,d)P^{30}$ near 25 MeV. The new value is ~ 0.1. A.

539.17

5374. ABSOLUTE CROSS SECTIONS FOR THE REACTIONS $B^{11}(\gamma,2p)Li^9$ AND $C^{12}(\gamma,3p)Li^9$. G.W.Tautfest.
Phys. Rev., Vol. 110, No. 3, 708-12 (May 1, 1958).

Activation curves for the reactions were obtained in the energy range 100-320 MeV. Targets of boron and carbon were exposed to the bremsstrahlung beam of the synchrotron and the yields of Li^9 measured by counting the delayed neutrons in a moderator-counter assembly surrounding the targets. The activation curves were analysed by the photon difference method to obtain the cross-section curves as a function of energy. Both cross-sections show a pronounced increase above 150 MeV, and have integrated values up to 320 MeV of 2.0 ± 0.3 MeV millibarns for the reaction $B^{11}(\gamma,2p)Li^9$ and 0.31 ± 0.05 MeV millibarn for the reaction $C^{12}(\gamma,3p)Li^9$. A.

539.17

5375. POLARIZATION OF NUCLEONS FROM THE $D(\gamma,p)n$ REACTION AT MEDIUM ENERGIES. W.Czyż and J.Sawicki.
Phys. Rev., Vol. 110, No. 4, 900-5 (May 15, 1958).

This is investigated under the assumption of tensor coupling in the n–p interaction potential. Electric dipole, electric quadrupole, magnetic dipole, and magnetic quadrupole transitions are taken into consideration. The polarization is estimated for $\hbar\omega$ = 65 MeV with the help of recent nucleon–nucleon scattering phase shifts. These estimates indicate the dominant role of the electric dipole and the magnetic dipole transitions from $^3S_1 + {}^3D_1$ ground state to the $^3P_0$, $^3P_1$, $^3P_2$, $^3F_2$, and $^1S_0$ final states. The advantages of the measurement of the polarization are indicated. A.

539.17

5376. INELASTIC SCATTERING OF PHOTONS IN Y^{89}. E.Silva and J.Goldemberg.
Phys. Rev., Vol. 110, No. 5, 1102-3 (June 1, 1958).

The cross-section for the inelastic scattering of photons in Y^{89} was measured from 4 to 22 MeV. Two peaks were observed, and their significance is discussed. A.

539.17

5377. CROSS SECTION FOR THE $Al^{27}(\gamma,2p)Na^{25}$ REACTION TO 65 MeV. L.B.Aull and W.D.Whitehead.
Phys. Rev., Vol. 110, No. 5, 1113-15 (June 1, 1958).

The $Al^{27}(\gamma,2p)Na^{25}$ cross-section was determined from 25 to 65 MeV with respect to the $Cu^{63}(\gamma,n)Cu^{62}$ cross-section. The cross-section has a maximum value of 0.29 mb at 32 MeV and the integrated cross-section from 25 to 64 MeV is 2.8 MeV mb. A.

539.17

5378. PHOTONEUTRON REACTIONS IN LITHIUM. T.W.Rybka and L.Katz.
Phys. Rev., Vol. 110, No. 5, 1123-6 (June 1, 1958).

The photoneutron cross-section for the (γ,n) reaction in natural lithium was measured and found to have its maximum at 16.8 MeV, a peak value of 2.3 mb, and a width at half maximum of 9.3 MeV. Fine structure in the region to 10 MeV was resolved as follows: $Li^6(\gamma,np)He^4$ threshold at 3.61 ± 0.15 MeV, $Li^6(\gamma,p)He^5$ threshold at 4.64 ± 0.08 MeV, a level in Li^6 at 5.24 ± 0.05 MeV, $Li^6(\gamma,n)Li^5$ threshold at 5.73 ± 0.05 MeV, $Li^7(\gamma,n)Li^6$ threshold at 7.30 ± 0.04 MeV, and a level in Li^7 at 9.66 ± 0.04 MeV. A.

539.17

5379. CORRELATED NEUTRON–PROTON PAIRS FROM THE HIGH-ENERGY PHOTODISINTEGRATION OF HELIUM AND LITHIUM. M.Q.Barton and J.H.Smith.
Phys. Rev., Vol. 110, No. 5, 1143-55 (June 1, 1958).

Observations were made on the protons and neutrons simultaneously ejected from helium and lithium by 280 MeV bremsstrahlung. All photoprotons were found to be accompanied by a neutron. The results are interpreted in terms of Levinger's quasideuteron theory of photodisintegration (Abstr. 9709/1951). The results lead to a measurement of the low momentum spectrum in helium and lithium as well as identification of the high-momentum components of the momentum spectrum as due to two-particle interactions. A

539.17

5380. PHOTOPROTONS FROM N^{15}.
J.L.Rhodes and W.E.Stephens.
Phys. Rev., Vol. 110, No. 6, 1415-19 (June 15, 1958).

The photoprotons ejected by bremsstrahlung photons from nitrogen gas enriched in N^{15} were detected in nuclear emulsions and the proton energy and angular distributions measured for 18.7 and 24.6 MeV betatron energies. The photoproton yield is 10^5 protons per atomic weight per roentgen unit at 24.6 MeV. The integrated cross-section in the giant resonance is 10 MeV millibarns for ground-state transitions. Structure is observed in the giant resonance and the angular distributions in this region are predominantly $\sin^2\theta$. A.

539.17 : 539.12

5381. PRODUCTION OF PROTON–ANTIPROTON PAIRS BY HIGH-ENERGY γ-QUANTA. Yu.A.Vdovin.
Zh. éksper. teor. Fiz., Vol. 32, No. 3, 542-6 (1957). In Russian.
English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 3, 452-5 (Oct., 1957).

The production of proton–antiproton pairs by high-energy γ-quanta on nuclei is investigated by a semi-phenomenological method. A knowledge of the asymptotic expression of the function f each nucleon is sufficient for the computation of the effective cross-section. On the assumption that the nucleus is "black" with respect to the nucleons, the asymptotic expression was found as a superposition of a plane and diffracted waves. The calculations are extended to the case of an arbitrary interaction law between the nucleons and nucleus. The differential cross-section is then expressed in terms of the amplitude of elastic scattering of nucleons in the nucleus. A.

539.17 : 539.14

DIRECT NUCLEAR PHOTOEFFECT. See Abstr. 5260

539.17 : 539.12

5382. NEUTRON SPECTRA EMITTED FROM THE (n,2n) REACTION ON Mn^{55}, I^{127} AND Ta^{181}. E.Remy and L.Winter.
C.R. Acad. Sci. (Paris), Vol. 246, No. 9, 1410-13 (March 3, 1958).
In French.

Targets of Mn^{55}, I^{127} and Ta^{181} were irradiated by 14 MeV neutrons and the spectra of emitted neutrons produced by the (n,2n) reactions were measured by a time-of-flight method. Neutron groups due to the (n,2n) reactions were resolved and the shape of the spectra in the case of I^{127} indicates that at least some of the neutrons were emitted in cascade rather than simultaneously.
A.E.I.Research Laboratory

539.17

5383. REACTOR NEUTRON CAPTURE CROSS SECTION OF 51-DAY Sr^{89}. L.P.Roy and J.C.Roy.
Canad. J. Phys., Vol. 35, No. 10, 1215-19 (Oct., 1957).

The neutron capture cross-section of Sr^{88} was measured by an activation method. Naturally occurring strontium was irradiated in different high flux positions in the N.R.X. reactor at Chalk River and the amount of Sr^{90} formed by successive neutron capture in Sr^{88} was determined by separating and measuring its daughter Y^{90}. Using values of 36.6 and 0.005 barns for the respective neutron capture cross-sections of Co^{59} and Sr^{88}, the capture cross-section of Sr^{89} for reactor spectrum neutrons was found to be 0.49 ± 0.10 barn.
A.

539.17

5384. NUCLEAR REACTIONS INDUCED BY THE 14 MeV NEUTRONS. S.Yasumi.
J. Phys. Soc. Japan, Vol. 12, No. 5, 443-53 (May, 1957).

The nuclear reactions of Al, Fe, Cu, Zn, Mo and Ag produced by neutrons from the $T^3(d,n)He^4$ reaction were investigated by means of the activation technique. The absolute numbers of activated nuclei in samples were determined by measuring the beta-rays from the samples with a 4π-proportional counter and applying the "method of extrapolation". By utilizing the variations of neutron energies in the laboratory system, an excitation curve of the $Mo^{92}(n, 2n)Mo^{91}$ reaction was obtained. For the cases of Al, Cu, Zn and Ag, the gradients of excitation curves were found. The experimental cross-sections were determined as follows: 87.2 mb ± 8% for $Al^{27}(n, p)Mg^{27}$; 20 mb ± 12% for $Al^{27}(n, \alpha)Na^{24}$; 144 mb ± 13% for $Fe^{56}(n,p)Mn^{56}$; 56 mb ± 5% for $Cu^{63}(n, 2n)Cu^{62}$; 119 mb ± 12% for $Zn^{64}(n, 2n)Zn^{63}$; 0.2 mb ± 12% for $Zn^{66}(n, p)Cu^{66}$; 132 mb ± 16% for $Mo^{92}(n, 2n)Mo^{91}$; 58 mb ± 11% for $Ag^{107}(n,2n)Ag^{106}$; and 604 mb ± 11% for $Ag^{109}(n,2n)Ag^{108}$. Comparing these results with predictions using the statistical theory of Weisskopf et al. it was found that they agreed with each other within about factor 3, with some discrepancies. The relative behaviour of excitation curve of the $Mo^{92}(n, 2n)Mo$ reaction seems to be consistent with the above theory, though with respect to the absolute values, the theoretical curve lies above the experimental one by about 2.4. A.

539.17

5385. A NOTE ON THE ISOTOPIC ASSIGNMENT OF SLOW NEUTRON RESONANCES IN SAMARIUM, IRIDIUM AND GADOLINIUM. E.M.Bowey and J.R.Bird.
Nuclear Phys., Vol. 5, No. 1, 294-6 (Jan., 1958).

Some further isotopic assignments of slow neutron resonances were made with the elements samarium, iridium and gadolinium, using a 15 MeV linear accelerator and capture gamma-ray scintillation detectors. A.

539.17

5386. (n,α) AND (n,p) REACTIONS IN FLUORINE.
E.Kondaiah, K.V.K.Iyengar and C.Badrinathan.
Nuclear Phys., Vol. 5, No. 2, 346-50 (Jan. [2], 1958).

The ratio of the (n,α) to (n,p) cross-section in F^{19} was experimentally measured for 14.5 MeV neutrons as 1.2; this ratio was calculated, on the basis of compound nucleus formation, to be 3.5. Comparing the calculated value with the experimentally observed value, it was concluded that either the continuum assumption is not valid in this particular case or direct interactions are playing a significant part especially in the (n,p) reaction. A.

539.17

5387. SCATTERING OF FAST NEUTRONS BY NEON 22.
C.P.Sikkema, P.J.Pasma and H.H.van Barneveld.
Nuclear Phys., Vol. 5, No. 2, 351-7 (Jan. [2], 1958).

The scattering of monoenergetic neutrons by Ne^{22} was studied in the neutron energy range 1.9 to 3.5 MeV, following a similar experiment carried out recently with natural neon (See Abstr. 9395/1957). The total cross-section of Ne^{22} shows 10 resonance maxima in this region, at neutron energies of 2.01, 2.14, 2.19, 2.32, 2.53, 2.72, 2.87, 3.10, 3.20 and 3.43 MeV. Determination of resonance parameters with the help of energy distributions of recoil nuclei appeared to be difficult in most cases. The peak at 2.32 MeV is most probably due to a superposition of a $P_{3/2}$ and a $D_{3/2}$ resonance. Excitation energies of Ne^{23} corresponding to peaks in the total cross-section of Ne^{22} were calculated using a value of 5.189 MeV for the neutron binding energy in Ne^{23}. A.

539.17

5388. THE ENERGY AND ANGULAR DISTRIBUTION OF PROTONS FROM 14 MeV NEUTRON REACTIONS WITH Cu.
D.L.Allan.
Nuclear Phys., Vol. 6, No. 3, 464-76 (April [1], 1958).

The energy and angular distributions of protons from the reactions $Cu^{63, 65}$ (n,p) and Cu^{63} (n,np) at 14 MeV were determined. The energy distributions in the forward direction exhibit peaks spaced many times the known level spacing of the residual nuclei. The angular distributions are symmetrical about 90° only for protons in the energy interval 2-3 MeV; the angular distributions for other energy intervals show a forward asymmetry which increases progressively with proton energy. A.

539.17

5389. NEUTRON TOTAL CROSS SECTIONS IN THE 7 TO 14 MeV REGION. A.Bratenahl, J.M.Peterson and J.P.Stoering.
Phys. Rev., Vol. 110, No. 4, 927-36 (May 15, 1958).

The neutron total cross-sections for 35 elements and isotopes were measured at several energies between 7 and 14 MeV using monoenergetic neutrons produced by a variable-energy cyclotron through the $D(d,n)He^3$ reaction. The effects of beam contamination by gamma-rays and low-energy "breakup" neutrons were evaluated through time-of-flight measurements and were kept small by suitably high bias on the plastic scintillator detector. The accuracy of the cross-sections is typically ± 1 to 2%. Where comparisons with previous data are possible, the agreement ranges from excellent to poor (10% discrepancy). The data form a smooth cross-section surface when plotted v. energy and mass number, as expected on the basis of the optical model. The functional dependence on energy and mass is not simple but is in good agreement with the predictions of the optical model of Bjorklund and Fernbach. A.

539.17

5390. ROTATIONAL-OPTICAL MODEL FOR SCATTERING OF NEUTRONS. D.M.Chase, L.Wilets and A.R.Edmonds.
Phys. Rev., Vol. 110, No. 5, 1080-92 (June 1, 1958).

The scattering of neutrons by a deformed, rotating, even-even nucleus is investigated with a diffuse-surfaced complex potential

employed. Two essential approximations, for which justification is presented, are made: (1) Nuclear excitations corresponding to I≥6 are ignored. (2) In the expansion of the nuclear potential, $V(r,\theta') = \Sigma\, v_\lambda(r)P_\lambda(\cos\theta')$, terms with $\lambda \geq 4$ are omitted. Comparison with earlier calculations by other authors, employing a distorted-wave Born approximation and δ-function interaction, indicates that the earlier work seriously overestimated direct excitation. At low energies (≲ 1 MeV), the excitation cross-section given by the direct process is small compared with excitation through the compound nucleus, but the direct process may contribute significantly to the angular distribution due to its large anistropy. The relevance of this work to the measurements of the differential cross-section for excitation of the I = 2 first excited level of U^{238} is discussed in some detail. The general features of the experimental variation of the strength function $\bar{\Gamma}_n^0/D$ and potential-scattering length R' with mass number at low energy are reproduced by a calculation with suitably varying deformation. A.

539.17

5391. NEUTRON NONELASTIC CROSS SECTIONS FROM 7 TO 14 MeV. W.P.Ball, M.MacGregor and R.Booth.
Phys. Rev., Vol. 110, No. 6, 1392-4 (June 15, 1958).

Neutron nonelastic cross-sections for seven elements were measured. The cross-sections are almost constant in this range, showing that variations in the total cross-sections are due primarily to variations in the elastic cross-sections. A.

539.17

5392. ELASTIC SCATTERING OF 14 MeV NEUTRONS FROM BERYLLIUM AND CARBON.
M.P.Nakada, J.D.Anderson, C.C.Gardner and C.Wong.
Phys. Rev., Vol. 110, No. 6, 1439-41 (June 15, 1958).

The angular distributions of elastically scattered 14 MeV (nominal energy) neutrons were measured for beryllium and carbon from 20° to 140°. Ring geometry, time-of-flight techniques, and relatively low detector biases were used. A comparison with optical-model calculations by Bjorklund and Fernbach indicates that the parameters that fit the medium and heavy elements do not yield satisfactory fits for beryllium and carbon. A.

539.17

5393. EXCITATION OF ROTATIONAL STATES IN THE INTERACTION BETWEEN NEUTRONS AND NUCLEI. V.N.Gribov.
Zh. éksper. teor. Fiz., Vol. 32, No. 4, 842-51 (1957). In Russian.
English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 4, 688-96 (Nov., 1957).

The excitation of rotational states in nuclei by neutrons is studied in the energy range from the threshold up to 1.5-2 MeV. A.

539.17

5394. NEUTRON INTERACTIONS WITH NUCLEI.
W.W.Havens, Jr.
Science, Vol. 127, 247-8, 250 (Jan. 31, 1958).

A review is presented of the various communications to the International Conference at Columbia University, New York, September 1957. Some emphasis is placed on the unsatisfactory state of the theory in relation to the experimental progress in this field; a more detailed description is needed for the slow neutron interactions (spheroidal cloudy-crystal-ball model) and the fission processes. It is also pointed out that in fast neutron physics the results of experiments with polarized neutrons presented at the conference do not agree with the theoretical calculations.

J.Lascoux

539.17 : 539.12

5395. DEUTERON CROSS SECTIONS FOR HIGH ENERGY PROJECTILES. J.S.Blair.
Nuclear Phys., Vol. 6, No. 3, 348-58 (April [1], 1958).

The absorption cross-section of a deuteron for high-energy particles is computed in a semi-classical model in which the elementary neutron and proton cross-sections are represented by classical black disks and the impulse approximation describes the collision. Computations were carried out for the Hulthén and Gartenhaus wave-functions and results are presented in graphical or tabular form. Approximate formulae and the sensitivity of the calculations to deuteron wave-function are discussed. Recent antiproton experiments imply that the shadow corrections are a large fraction of the antiproton–nucleon cross-sections. A.

539

5396. PROTONS AND ALPHA-PARTICLES FROM THE NITROGEN BOMBARDMENT OF ALUMINIUM. A.Zucker.
Nuclear Phys., Vol. 6, No. 3, 420-33 (April [1], 1958).

Aluminium targets, about 0.36 mg/cm² thick, were bombarded with 28 MeV nitrogen ions. The compound nucleus Ca^{41} is excited to 39.3 MeV and may decay by proton emission to K^{40}, and by alpha emission to A^{37}. Energy distributions for protons and alpha-particles were measured at six angles from 0° to 90°. The number of protons or alphas per unit beam, divided by the channel energy and the capture cross-section, plotted as a function of the square root of the excitation energy in the residual nucleus yields a value of a in the level density formula $w = C\exp[2(aE)^{1/2}]$. The data fit this formula well at all angles giving a = 5.0 ± 0.2 for K^{40}, and a = 4.1 ± 0.3 for A^{37}. Angular distributions were also measured and are reasonably isotropic for protons, whereas they show a definite forward peak for alpha-particles. An even-odd effect was found in the level density of the residual nuclei, K^{40} having about 2.5 times the level density of A^{37}. In general, the nitrogen- aluminium reaction bears out the predictions of the statistical theory for the decay of a compound nucleus. A.

539.17

5397. ON THE MECHANISM OF FISSION OF HEAVY NUCLEI. V.V.Vladimirskii.
Zh. éksper. teor. Fiz., Vol. 32, No. 4, 822-5 (1957). In Russian.
English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 4, 673-6 (Nov., 1957).

The effect of the state of individual nucleons on the shape of the nucleus prior to fission is studied. It is shown that the presence of excess nucleons with large values of the angular momentum projection on the symmetry axis of the nucleus may lead to loss of stability of the nucleus with respect to asymmetric deformations in the saddle point. This facilitates the explanation of some of the experimental facts. A.

539.17

5398. NEUTRON-INDUCED FISSION OF Ra^{226}.
R.A.Nobles and R.B.Leachman.
Nuclear Phys., Vol. 5, No. 1, 211-17 (Jan., 1958).

Energy distributions of single fragments from fission of Ra^{226} by neutrons from 4 to 21 MeV were observed. The distribution changes from a double peak for 4 MeV neutrons, through unequal double peaks for 8 MeV neutrons, to a single peak for 10 MeV neutrons. The cross-section for fission was found to rise from 0.5 millibarns for 2 MeV neutrons to 37 millibarns for 23 MeV neutrons. A.

539.17 : 539.12

5399. DELAYED NEUTRONS FROM FISSIONABLE ISOTOPES OF URANIUM, PLUTONIUM, AND THORIUM.
G.R.Keepin, T.F.Wimett and R.K.Zeigler.
Phys. Rev., Vol. 107, No. 4, 1044-50 (Aug. 15, 1957).

The periods, relative abundances, and absolute yields of delayed neutrons from "fast" fission of six nuclides (U^{238}, U^{233}, U^{235}, Pu^{239}, Pu^{240}, and Th^{232}) and thermal fission of three nuclides (U^{235}, U^{233}, and Pu^{239}) were measured. "Godiva", the bare U^{235} metal assembly at Los Alamos, was the neutron source. Six exponential periods were found necessary and sufficient for optimum least-squares fit to the data. Despite evident perturbations, general agreement among delayed-neutron periods was obtained for all nuclides. The absolute total delayed-neutron yield for each nuclide was measured for fast and thermal fission; a spectral effect was not observed. Representative of general delayed-neutron periods (half-lives) and abundances are the U^{235} fast-fission data:

Half-life (secs)	Rel. abundance	Half-life (secs)	Rel. abundance
54.51 ± 0.94	0.038 ± 0.003	2.23 ± 0.06	0.407 ± 0.007
21.84 ± 0.54	0.213 ± 0.005	0.496 ± 0.029	0.128 ± 0.008
6.00 ± 0.17	0.188 ± 0.016	0.179 ± 0.017	0.026 ± 0.003

These data have been corroborated in detail by independent period-v.-reactivity measurements on the bare U^{235} assembly. A comparison of the present results with a phenomenological theory of delayed-neutron emission is made. This treatment has led to the prediction of several new short-period delayed-neutron precursors. A.

539.17 : 523.03

5400. ON NUCLEAR REACTIONS IN VERY DENSE COLD HYDROGEN. Ya.B.Zel'dovich.
Zh. éksper. teor. Fiz., Vol. 33, No. 4(10), 991-3 (1957). In Russian.

It is shown that nuclear fusion reactions occuring in solid cold (below 10^8 K) hydrogen at densities of 10^4–10^6 g/cm³ by quantum-mechanical penetration under the potential barrier proceed with a probability that is fully perceptible on an astrophysical scale. This circumstance puts a limit on the possible compression of cold hydrogen, since at a density of 0.7×10^8 g/cm³

a celestial body cannot live longer than 10^8 years. Such a density is achieved in cold hydrogen under the action of gravitation in the case of a mass close to the mass of the sun. A.

539.17

5401. REACTORS OF MINIMUM CRITICAL MASS.
J. Devooght.
Bull. Acad. Roy. Belgique Cl. Sci., Vol. 43, No. 9, 653-62 (1957).
In French.

The distribution of fissile material corresponding to a distribution of moderating material, and to a given neutron flux, is determined for the case of two half-spaces separated by a plane surface, by solving the Boltzmann transport equation for one group of neutrons. A method of generalizing the solution for thermal neutrons is mentioned. T.O.Jeffries

539.17

5402. PLASMA REACTOR PROMISES DIRECT ELECTRIC POWER. S.A.Colgate and R.L.Aamodt.
Nucleonics, Vol. 15, No. 8, 50-5 (Aug., 1957).

A proposal for a fission-plasma reactor. A cylindrical reaction chamber 25 ft diameter and 150 ft long is surrounded by a moderator and contains high temperature U^{235} gas at 1 atm pressure. The gas becomes critical when compressed at one end of the cylinder. The fission energy then creates a shock wave which drives gas to the other end of the cylinder where it is again compressed, so that the gas oscillates from end to end of the cylinder at about 20 c/s. The central section of the tube is surrounded by current carrying coils and the oscillation of the highly ionized gas through the magnetic field transfers energy to an external resonant circuit. The electrical power output would be about 500 MW and the overall efficiency about 20%. R.D.Smith

539.17

5403. CALCULATING SPATIAL DISTRIBUTION OF REACTIVITY COEFFICIENTS. H.E.Stone.
Nucleonics, Vol. 15, No. 9, 185-8 (Sept., 1957).

The total reactivity coefficient is split into four components corresponding to variation of (a) fission cross-section; (b) diffusion coefficient; (c) absorption cross-section; (d) slowing-down cross-section. Expressions for these components based on perturbation theory are given for the temperature coefficient of reactivity. Combination of these components with the flux derived from multi-group calculations gives the required reactivity coefficient.

R.D.Smith

539.17

5404. "METALLO-ORGANIC" POLYMERS—POSSIBLE FUEL MATERIALS. A.J.Restaino.
Nucleonics, Vol. 15, No. 9, 189-91 (Sept., 1957).

Polymers of mono- and dicarboxylic acids with chemically bound uranium have high hydrogen content, excellent heat and radiation stability and complete homogeneity, and may prove suitable for use in nuclear reactors. The preparation of the materials and some of their properties are described. R.D.Smith

539.17

5405. FUEL REPROCESSING BY AQUEOUS METHODS.
E.L.Anderson, Jr.
Nucleonics, Vol. 15, No. 10, 72-7 (Oct., 1957).

Original processes for recovery of U and Pu from irradiated Al-alloy fuels were extraction by methyl iso-butyl ketone ("Redox") or tributyl phosphate ("Purex"). Th can be processed by a modified Purex process, though the 27 day half-life of Pa^{233} necessitates increased cooling time or separate treatment of the Pa stream. Improvements are obtained by the substitution of continuous processing (based on ever-safe geometry) for batch processing and by the use of pulsed columns or mixer-settler extractors. Stainless steel or Zr-clad fuels need special treatment before feeding into existing plants. R.D.Smith

539.17

5406. CALCULATING GAMMA HEATING IN REACTOR STRUCTURES.
H.C.Claiborne, C.M.Copenhaver, H.W.Bertini and T.B.Fowler.
Nucleonics, Vol. 15, No. 10, 114-21 (Oct., 1957)

The heating of Pb, Fe, and Al samples in the Bulk Shielding Reactor was calculated and compared with experimental results. Heating by core gammas, by water-capture gammas and target capture gammas was considered. The main contribution, from core gammas, was calculated by summing the effects of small volume elements in the core, assuming exponential absorption, narrow beam absorption coefficients and appropriate build-up factors. The source gammas are prompt fission γ's, fission-product γ's, capture γ's from U, H_2O and Al, decay γ's from Al and inelastic scattering γ's, and were divided into seven energy groups. Build-up factors were calculated by finding the build-up in a material of an atomic number having the same absorption as the mixture of materials present. (This method is inaccurate if a layer of low-Z material is followed by high-Z material). The calculated values agreed with experimental values within +5% to −15%. R.D.Smith

539.17 : 669

5407. REMOTE FUEL FABRICATION — HOW IT WAS DONE FOR E.B.R.-II. A.S.Shuck.
Nucleonics, Vol. 15, No. 12, 50-3 (Dec., 1957).

The implications of remote-controlled methods of processing highly active reactor fuels, including effects due to the intense γ-radiation, are considered. A system for vacuum casting E.B.R.-II fuel pins in glass moulds is described in detail.

R.D.Smith

539.17

5408. FISSION-PRODUCT MONITORING IN REACTOR COOLANT WATER. R.L.Heath.
Nucleonics, Vol. 15, No. 12, 54-8 (Dec., 1957).

Scintillation counters were used to examine the spectra of γ-rays emitted from fission products adsorbed from the cooling water on ion-exchange resins. The fission products adsorbed on anion and on cation resins were identified. After passing the water through a cation resin the γ-rays above 300 keV emitted from the fission products adsorbed on an anion resin are solely due to the iodine isotopes. A fission product monitor based on this principle has operated satisfactorily and is more sensitive than either direct detection of a particular γ-ray or delayed neutrons.

R.D.Smith

539.17 : 539.12

5409. EFFECTIVE CADMIUM CUTOFF ENERGY.
I.E.Dayton and W.G.Pettus.
Nucleonics, Vol. 15, No. 12, 86-8 (Dec., 1957).

Effective cutoff energy is defined as that of a perfect filter that allows the same total number of absorptions in a sample. The calculation of the cut-off for the case of a 1/V absorber screened by a cadmium filter is considered in detail for both isotropic and unidirectional fluxes. Results of the calculations are presented in the form of graphs which enable the effective cutoff energy to be determined when the spectrum of the incident flux varies as 1/E. Scattering in the absorber is negligible. R.D.Smith

539.17 : 518.5

5410. ELECTRICAL ANALOG SOLVES REACTOR DESIGN PROBLEMS. S.Nagao.
Nucleonics, Vol. 16, No. 1, 88-90 (Jan., 1958).

Differential equations of the diffusion type can be solved using an analogue device consisting of a resistive film which forms one plate of a parallel plate condenser. A voltage signal with a saw-tooth exponential waveform is applied along appropriate boundaries of the film and it is shown that the distribution of the peak voltage then corresponds to the spatial distribution of neutron flux.

R.D.Smith

539.17 : 621.311.25 : 681.142

5411. THE APPLICATION OF DIGITAL COMPUTERS TO NUCLEAR-REACTOR DESIGN. J.Howlett.
Proc. Instn Elect. Engrs, Paper 2507M, publ. Jan., 1958 (Vol. 105B, 331-6, 365-9).

Republication, with discussion, of the paper abstracted in Abstr. 769 (1958).

539.17

5412. TEMPERATURE TRANSIENTS IN GAS-COOLED THERMAL NUCLEAR REACTORS. J.H.Bowen and E.F.O.Masters.
Proc. Instn Elect. Engrs, Paper 2422M, publ. Oct., 1957 (Vol. 105B, 337-48, 365-9).

Republication, with discussion, of the paper abstracted in Abstr. 9895 (1957).

539.17 : 621.762

STEPS IN PREPARING URANIUM DIOXIDE FOR FUEL ELEMENTS. See Abstr. 4611

539.17

5413. ON THE POSSIBILITY OF CONTROLLED POWER PRODUCTION USING THERMONUCLEAR FUSION.
G.Kálmán, L.Pócs, G.Schmidt and K.Simonyi.
Periodica polytech., Elect. Engng, Vol. 1, No. 1, 53-71 (1957).

Discussion of power balance, and of containment, including magnetic mirror and double solenoid methods. R.S.Pease

539.17 : 669

5414. DESIGN AND COST ESTIMATE FOR A PYROMETALLURGICAL REPROCESSING PLANT. L.Basel and J.Koslov. Nucleonics, Vol. 15, No. 8, 56-60 (Aug., 1957).

A design is given for a plant for the purification of spent fuel from fast reactors. The fuel is held at 2400° F for 4 hr, the fission products being removed as gases or as oxides in the slag layer formed. Noble-metal fission products remain in the fuel and their build-up is limited by an aqueous processing of 5% of the metal. R.D.Smith

ATOMS

539.18 : 535.331/.332

5415. ORBIT–ORBIT INTERACTIONS IN ATOMIC SPECTRA. C.W.Ufford and H.B.Callen. Phys. Rev., Vol. 110, No.6, 1352-4 (June 15, 1958).

Empirical spectroscopic evidence suggests the existence of an orbit–orbit interaction between electrons, of the form $\alpha\vec{l}_1\cdot\vec{l}_2$, and of a magnitude comparable to the spin–orbit interaction. The direct magnetic interaction is of this form, but previous calculations have yielded too small a magnitude. It is suggested that the magnetic interaction is uniquely sensitive to the correlation of the interacting electrons, and that introduction of a reasonable correlation in the wave-function may well increase the magnetic interaction to the magnitudes required by the empirical data. A.

539.18

5416. STATISTICAL EQUILIBRIUM OF TRIPLET LEVELS OF NEUTRAL HELIUM. J.S.Mathis. Astrophys. J., Vol. 125, No. 2, 318-27 (March, 1957).

The mode of depopulation of the $2\ ^3S$ level of helium in a very dilute radiation field is examined. The probablity per second of transitions to the ground state from the $2\ ^3S$ level by two-photon emissions is estimated to be 2.2×10^{-5} sec^{-1}, and transitions via superelastic collisions are found to compete with two-photon emission in nebulae of densities of 10^3 electrons/cm^3 or higher. Transitions to the ground state from the $2\ ^3S$ level are found to be more important than radiative excitations and ionizations if the dilution factor of the radiation is less than 10^{-12}. Under such conditions the populations of the triplet terms are independent of the properties of the exciting star. The population parameters, b_1, defined by Menzel (1937), are given for eighteen of the low triplet terms for electron temperatures from 8000° to 20 000°K. The importance of inelastic and exchange collisions is estimated. Observational evidence from planetary nebulae is found to support satisfactorily the theoretical prediction of the ratio of the strengths of He I λ 4471 and λ 5876. A.

539.18

5417. OPTICAL ORIENTATION OF ATOMS IN THE SATURATED VAPOUR OF CAESIUM. T.Skalinsky. C.R. Acad. Sci. (Paris), Vol. 245, No. 22, 1908-11 (Nov. 25, 1957). In French.

Magnetic resonances between the Zeeman levels of the ground state ($6^2S_{\frac{1}{2}}$) of Cs were studied using the optical orientation method. Single, double and triple quantum transitions were observed, which agree closely with theory. The influences of the foreign gases H_2 and Xe upon the resonances were also studied. R.W.Nicholls

539.18

5418. THE DECAY OF THE POPULATIONS OF METASTABLE ATOMS AND IONS FROM THE SAME D.C. DISCHARGE IN NEON. B.C.Blevis, J.M.Anderson and R.W.McKay. Canad. J. Phys., Vol. 35, No. 8, 941-53 (Aug., 1957).

Measurements of electron density and of the population of the $^3P_2$ metastable state were made following cessation of a d.c. discharge in neon gas. Determinations of these populations were made under identical conditions at accurately determined times after termination of the discharge and decay curves were plotted for a pressure range from 0.5 to 12.0 mm Hg. At low pressures, where diffusion is the principal factor in the decay, both curves are exponential and show the same mean life within the limits of error. Values of the diffusion constants obtained from these curves are consistent with the results of previous workers in both fields. At higher pressures the metastable decay remains exponential while the reciprocal of the electron population changes linearly with time. In general, the two decays are unrelated. Only at the highest pressure studied, and in this case for only the first half millisecond, was a measurable effect of positive ion recombination found in the metastable population curve. A.

539.18

5419. RELATIVISTIC CALCULATION OF THE IMAGINARY PART OF RADIATIVE LEVEL DISPLACEMENT FOR THE HYDROGEN ATOM. L.Kaagjärv and S.T.Ma. Nuovo Cimento, Vol. 8, No. 3, 432-40 (May 1, 1958).

Starts with a quantum-electrodynamical expression for the self energy of a bound electron which has been used in the latest calculation of the Lamb shift. The imaginary part of this self energy is considered to the same degree of accuracy as the Lamb shift. The results for the 2S and 2P levels are compared with the non-relativistic results calculated along the lines of a paper by Weisskopf and Wigner. It is found that there are no relativistic corrections to the desired order of accuracy. A.

539.18 : 539.165

5420. IONIZATION FOLLOWING BETA DECAY IN KRYPTON-85. A.H.Snell and F.Pleasonton. Phys. Rev., Vol. 107, No. 3, 740-5 (Aug. 1, 1957).

Following beta decay in the 9.4 year radioactivity of Kr^{85}, the product rubidium atoms are found to be distributed in the following charge spectrum (figures in percent): charge 1, 79.2 ± 1.0; charge 2, 10.9 ± 0.2; charge 3, 3.9 ± 0.1; charge 4, 3.1 ± 0.1; charge 5, 1.51 ± 0.07; charge 6, 0.66 ± 0.04; charge 7, 0.40 ± 0.02; charge 8, 0.19 ± 0.02; charge 9, 0.093 ± 0.01; charge 10, 0.026 ± 0.006; charge 11, unobservable. An interpretation is made in terms of the "shaking off" of extranuclear electrons by the sudden change by +1 in the nuclear charge, the intensity of the charge-2 ions being taken as a direct measure of the probability of "shake-off" from the combined 4s and 4p shells. The combined intensities of charge 3 and higher are correspondingly equated to the summed probabilities of primary ionizations in the n = 1, 2, and 3 shells. A.

539.18 : 539.165

5421. SINGLE ELECTRON SHAKEOFF PROBABILITY FOLLOWING THE BETA DECAY OF KRYPTON. A.E.S.Green. Phys. Rev., Vol. 107, No. 6, 1646-50 (Sept. 15, 1957).

In view of the experimental work of the preceding abstract, which indicates that the product atom following the beta decay of krypton is frequently left in high states of ionization, it is of interest to attempt a calculation of "shakeoff" probabilities for all the outermost occupied configurations. The method of calculation used essentially follows the formulations of Migdal (Abstr. 516/1941), Feinberg (Abstr. 517/1941), Levinger (Abstr. 4332/1953) Schwartz (Abstr. 1892/1953) and earlier workers. The details of the calculations are governed to a considerable extent by the availability of Rb^+ Hartree wave-functions. The innovations which are attempted involve (1) the use of newly determined analytical approximations to Hartree functions, (2) the use of a simple scaling technique, and (3) the extension of the work to the outermost occupied levels. Comparisons of the calculated shakeoff probabilities with those inferred from experiment by Snell and Pleasonton are made. The agreement is fairly satisfactory. It is believed that some of the innovations used here might be useful for other types of atomic calculations. A.

539.18

5422. THEORY OF THE FORBIDDEN TRANSITIONS OF NITROGEN ATOMS TRAPPED IN SOLIDS. C.M.Herzfeld. Phys. Rev., Vol. 107, No. 5, 1239-45 (Sept. 1, 1957).

A detailed theory is given. The trapped atoms are perturbed by the solid. Configuration interaction, produced by the solid, is important. Splittings and shifts of levels, and reduction of half-lives are explained in one consistent scheme. The trapping sites of atoms are shown to have low symmetry and to be nearly identical for different atoms. A.

539.18

5423. ELECTRONIC POLARIZABILITY OF IONS. R.M.Sternheimer. Phys. Rev., Vol. 107, No. 6, 1565-9 (Sept. 15, 1957).

The dipole polarizability α_d and the quadrupole polarizability α_q are calculated for several ions by solving the Schrödinger equation satisfied by the first-order perturbation of the wave-functions of the electrons of the core. The results for α_d of the helium-like ions are in good agreement with those obtained previously by an analytic method. The calculated quadrupole polarizability α_q of the alkali ions increases very rapidly with increasing Z, from 0.056 A^5 for Na^+ to 7.80 A^5 for Cs^+. A.

539.18

5424. OPTICALLY DETECTED FIELD-INDEPENDENT TRANSITION IN SODIUM VAPOR. W.E.Bell and A.L.Bloom.
Phys. Rev., Vol. 109, No. 1, 219-20 (Jan. 1, 1958).

The $\Delta F = 1$, $m_F = 0 \rightarrow m_F = 0$ hyperfine transition of the ground state of Na^{23} was observed using magnetic depolarization techniques and an argon optical buffer. The line was distinguished from the other hyperfine components by its apparent independence of magnetic field (see, however, the abstract following). Preliminary observations upon comparable transitions in K^{39} were unsuccessful as the hyperfine splitting is here comparable to the line width (462 Mc/s). R.W.Nicholls

539.18

5425. OPTICAL DETECTION OF THE ZERO-FIELD HYPERFINE SPLITTING OF Na^{23}. M.Arditi and T.R.Carver.
Phys. Rev., Vol. 109, No. 3, 1012-13 (Feb. 1, 1958).

The hyperfine splitting ($\Delta F = 1$, $m_F = 0 \rightarrow m_F = 0$ transition) of the ground state of Na^{23} was measured by use of the magnetic depolarization method with rare gas optical buffers to reduce Doppler line-width. The splitting is $(1771.6262 + 0.0022H^2) \times 10^6 \pm 100$ c/s. R.W.Nicholls

539.18

5426. HYPERFINE STRUCTURE OF TECHNETIUM-99 FROM PARAMAGNETIC RESONANCE. W.Low and P.M.Llewellyn.
Phys. Rev., Vol. 110, No. 4, 842-3 (May 15, 1958).

The hyperfine structure of tetravalent Tc^{99} in a single crystal of K_2PtCl_6 was detected at 1.25 cm wavelength and at the temperature of the boiling point of liquid helium. The significant parameters are: $g = 1.9896 \pm 0.0005$, $A_{max} = 148.8 \pm 0.4$ gauss, $A_{min} = 144.0 \pm \pm 0.4$ gauss. The nuclear spin is confirmed as 9/2. An additional six isotropic lines with $g = 2.050 \pm 0.005$ and $A = 109 \pm 3$ gauss are found at liquid nitrogen temperature. These hyperfine lines may possibly be due to the rhenium isotopes 185 and 187 with nuclear spins 5/2. A.

539.18 : 539.2

5427. PARAMAGNETIC RESONANCE ABSORPTION IN Mn-ACTIVATED HEXAGONAL ZnS.
S.P.Keller, I.L.Gelles and W.V.Smith.
Phys. Rev., Vol. 110, No. 4, 850-5 (May 15, 1958).

The absorption spectrum of divalent Mn incorporated into hexagonal ZnS was determined. The anisotropic behaviour of the absorption was measured, yielding the crystalline field parameters $D = -113 \pm 2$ and $F = -8.1 \pm 1$ oersteds. The g value and hyperfine splitting were observed to be isotropic, with values, respectively, of 2.0016 ± 0.0001 and of -70 ± 1 oersteds. A.

539.18

5428. APPROXIMATE WAVE FUNCTIONS FOR THE GROUND STATE OF HELIUM. R.K.Nesbet and R.E.Watson.
Phys. Rev., Vol. 110, No. 5, 1073-6 (June 1, 1958).

Approximate ^1S electronic wave-functions for the ground state of the helium atom are obtained by the method of superposition of configurations. Parameters determining the radial factors of orbitals, with spherical harmonic angular factors up to $l = 3$, were varied to minimize the calculated energy. For each choice of the ten parameters varied in this way, a complete calculation was carried out, involving the construction and diagonalization of the twenty-by-twenty configuration interaction matrix obtained from all independent ^1S functions determined by the ten independent orbital radial factors. The best energy obtained was -2.90276 atomic units, differing from the experimental value by 0.001 atomic unit. A.

539.18

5429. EFFECT OF THE IMPRISONMENT OF RESONANCE RADIATION ON EXCITATION EXPERIMENTS. A.V.Phelps.
Phys. Rev., Vol. 110, No. 6, 1362-8 (June 15, 1958).

The theory of the imprisonment of resonance radiation developed by Holstein and by Bieberman is applied to the analysis of experimental measurements of excitation cross-sections for the resonance ($n\,^1P$) states of helium. The transport equation for the density of atoms in the resonance state is solved numerically for the case of a thin sheet of exciting electrons between parallel plane electrodes. The fraction of the resonance atoms producing visible radiation is then calculated for parallel plane geometry and estimated to within 5% for cylindrical geometry with an axial electron beam. Predictions of the theory are compared with the available experimental data for helium. The theory shows that at the helium pressures commonly used (10^{-3} to 10^{-1} mm of Hg) the observed visible radiation may easily be a factor of ten greater than that expected when imprisonment effects are neglected. As a result, the cross-section for the excitation of the $n\,^1P$ states given in the literature are much too large. For example, analysis of the available experimental data suggests that the cross-section for excitation by electrons to the $3\,^1P$ state of helium at 100 eV is 3×10^{-18} cm^2 instead of 4×10^{-17} cm^2 as given in the literature. A.

539.18

5430. NUCLEON SIZE CONTRIBUTIONS TO THE HYPERFINE STRUCTURE OF HYDROGEN AND HELIUM.
A.M.Sessler and R.L.Mills.
Phys. Rev., Vol. 110, No. 6, 1453-7 (June 15, 1958).

The effect of the electromagnetic structure of the proton and neutron upon the hyperfine splitting of S states in hydrogen and helium is calculated nonrelativistically. Convenient formulae are given, assuming that the charge and moment distributions of the proton and neutron are Gaussian. A summary of calculations of nuclear structure effects in deuterium is given and the present experimental situation is reviewed. If there is no relativistic or interaction moment contribution to the magnetic moment of the deuteron, the percent D state is 3.9, which is, under the same assumptions, consistent with the hyperfine splitting of deuterium. A.

539.18

5431. WAVE FUNCTIONS FOR THE NORMAL STATES OF Ne^{+3} AND Ne^{+4}. C.Froese and D.R.Hartree.
Proc. Cambridge Phil. Soc., Vol. 53, Pt 3, 663-8 (July, 1957).

Solutions of Fock's equations for the self-consistent field with exchange were carried out for Ne^{+4}, using the EDSAC. The initial estimates for the calculation were made by a simplified version of a method previously suggested for interpolating atomic wave-functions with respect to atomic number. This gave good estimates for Ne^{+4}, and it is probable that estimates for Ne^{+3}, obtained similarly, are already accurate enough for practical use. Such wave-functions for Ne^{+3} are given. The results have application in astrophysical contexts. A.

539.18

5432. ENERGY LEVELS OF THE TWO-ELECTRON ATOM TO ORDER α^3ry; IONIZATION ENERGY OF HELIUM. J.Sucher.
Phys. Rev., Vol. 109, No. 3, 1010-11 (Feb. 1, 1958).

The α^3ry corrections to the ground-state energy of the helium atom are calculated from a Bethe—Salpeter equation, (extended to the case where an external field is present), using a "mixed gauge" in which the interaction between the electrons is described in a Coulomb gauge while self-interaction is treated in a covariant gauge. The results agree with those obtained by Araki and, if they are combined with those obtained by Kinoshita for the terms up to α^3ry and by Kabir and Salpeter for the main α^3ry corrections, yield a value of the ionization energy $J_{theor} = 198\,310.31$ cm^{-1} to be compared with the experimental result $J_{exp} = 198\,310.5 \pm 1$ cm^{-1} P.K.Kabir

539.18

5433. ATOMIC MASSES FROM PHOSPHORUS THROUGH MANGANESE. C.F.Giese and J.L.Benson.
Phys. Rev., Vol. 110, No. 3, 712-20 (May 1, 1958).

Atomic masses of all the stable isotopes of the elements from phosphorus through manganese were measured with a large double-focusing mass spectrometer. The comparison with previous mass spectroscopic results presents a varying pattern of agreement and disagreement. The agreement of the present mass measurements with results from microwave spectroscopy is, in general, good. The present masses agree much better with Q-value determinations than do previous masses. The remaining differences appear to be systematic. It would appear to be symptomatic of the discrepancies that in all cases, 10 in number, in which a (p,α) Q-value can be predicted from the present measured masses, the measured Q-value is less than the predicted value. The present paper includes a tabulation of masses of unstable nuclei. In addition, tables and plots of nucleon separation and total nucleon pairing energies for this mass region are included. A.

539.18 : 535.332

5434. QUANTITATIVE ISOTOPIC ANALYSIS OF HYDROGEN, DEUTERIUM AND TRITIUM MIXTURES BY A SPECTROGRAPHIC METHOD. M.N.Oganov and A.R.Striganov.
Atomnaya Energiya, Vol. 2, No. 8, 112-20 (1957). In Russian.

The relative intensities of the H_α and D_α lines photographed on a glass prism spectrograph were used and conversion to concentrations made by calibration graphs previously constructed from standard gas mixtures. The effect of gas pressure was experimentally

examined and the influence of Doppler widths and dissociation energies discussed. The range 0.7 to 97% H_2 in D_2 is covered and possible applicability to tritium analysis considered. L.Bovey

539.18

5435. MASSES OF THE LEAD ISOTOPES.
R.A.Demirkhanov, T.I.Gutkin and V.V.Dorokhov.
Dokl. Akad. Nauk SSSR, Vol. 118, No. 6, 1103-4 (1958). In Russian.

Precise mass-spectrometric measurements for Pb^{204}, Pb^{206}, Pb^{207}, Pb^{208} are given [in agreement, within 0.0003 a.m.u. with the data obtained from nuclear reactions]. J.Lascoux

539.18 : 535.338.333

5436. ISOTOPIC SPECTRAL ANALYSIS OF LEAD BY A PHOTOELECTRIC METHOD. A.G.Zhiglinskii.
Optika i Spektrosk., Vol. 3, No. 1, 9-15 (1957). In Russian.

A Fabry–Perot interferometer with a multilayer dielectric coating (reflectance of 87%) was used with a water- or liquid-nitrogen-cooled hollow cathode as source. Liquid-nitrogen cooling increased measurement accuracy by a factor of two. The spectra were recorded photoelectrically. The isotopes Pb^{206}, Pb^{207} and Pb^{208} were determined from the 4058 A line with consideration being given to the hyperfine structure. The error is expressed as the difference between the mass-spectrographic and the optical spectrometric figures divided by the mass-spectrographic figures. This equals about 4% for isotope concentrations between 10 and 100%. Pb^{204} (present to about 1%) could be determined with an error of 20% and a correction for its presence in a mixture is neglected. Between 0.5 and 2 mg of sample are required, and two hours are required for one determination. L.Bovey

539.18 : 539.12

5437. POLARIZATION AND EXCHANGE EFFECTS IN THE SCATTERING OF ELECTRONS FROM ATOMS WITH APPLICATION TO OXYGEN. A.Temkin.
Phys. Rev., Vol. 107, No. 4, 1004-12 (Aug. 15, 1957).

A method is developed to include polarization effects in low-energy scattering of electrons from atoms, within the Hartree–Fock formalism. This description is different from the usual expansion in terms of the eigenfunctions of the atom. The method associates with each atomic orbital perturbed or polarized parts which also depend parametrically on the coordinates of the scattered particle. When the orbital function of the scattered particle is appropriately antisymmetrized with the total atomic function, augmented in this manner, a set of equations result which, in addition to the no-polarization terms, contain terms coming from the polarized orbitals. By virtue of the antisymmetry, these terms are of two kinds: direct and exchange. The direct terms lead asymptotically to the classical type of polarizability correction which was used by Bates and Massey. The exchange terms constitute a specifically quantum mechanical correction. This method is applied, in a certain approximation, to the s-wave scattering of electrons from oxygen. Only the most important kind of polarized orbital is taken into account. Within this approximation the exchange polarized terms make a contribution of approximately 15% to the cross-section. A.

539.18

5438. ELASTIC SCATTERING OF ELECTRONS BY HELIUM AND HYDROGEN ATOMS IN GROUND QUANTUM STATES. V.Šachl.
Phys. Rev., Vol. 110, No. 4, 891-9 (May 15, 1958).

The direct and exchange scattering amplitudes for helium $(1s)^2$ with antiparallel spins in a three-body approximation, and for hydrogen 1s, are treated. The fundamental differential and integral equations are arrived at by using a simple atomic model given by Allis and Morse. Analytical formuae for differential elastic cross-sections are derived for the collisions of an unpolarized electron wave with helium and hydrogen atoms in the above-mentioned quantum states. The second Born approximation is given, and distortion and exchange effects are taken into consideration. The exchange effect is calculated in the second Born approximation and the perturbed exchange integral is calculated analytically to a good degree of approximation. The analytical formulae derived for higher scattering angles are in qualitative agreement with experimental results in the low-energy range. A.

539.18

5439. THE PARTIAL WAVE THEORY OF ELECTRON–HYDROGEN ATOM COLLISIONS. I.C.Percival and M.J.Seaton.
Proc. Cambridge Phil. Soc., Vol. 53, Pt 3, 654-62 (July, 1957).

The paper is concerned with the solution of the algebraic problems arising in the partial wave treatment of electron- hydrogen atom collisions. Explicitly antisymmetrized wave-functions are used throughout. The boundary conditions are written in S-matrix notation and expressions for total and differential cross-sections obtained. The algebraic coefficients f_λ and g_λ occurring in the continuous state Hartree–Fock equations are expressed in terms of Racah coefficients, and tabulated as functions of the total angular momentum for atomic s, p and d electrons and all angular momenta of the scattered electron. Expressions are given for the calculation of first-order corrections to the results obtained using approximate wave-functions. A.

539.18

5440. CALCULATION OF THE 1s–2s ELECTRON EXCITATION CROSS SECTION OF HYDROGEN. R.Marriott.
Proc. Phys. Soc., Vol. 72, Pt 1, 121-9 (July, 1958).

The zero-order partial cross-section for the excitation of hydrogen from the (1s) to the (2s) states by electron collision was calculated by a numerical method. Full allowance has been made for electron exchange and all direct coupling between the initial and final atomic states was retained. The cross-sections obtained are compared with those that were calculated by more approximate methods. In particular, the cross-section near the threshold was found to be considerably smaller than that given by Erksine and Massey (Abstr. 5996/1952) using the distorted-wave approximation. A.

539.18

5441. IMPACT PARAMETER TREATMENT OF CERTAIN HYDROGEN–PROTON AND HYDROGEN–HYDROGEN EXCITATION COLLISIONS. D.R.Bates.
Proc. Roy. Soc. A, Vol. 245, No. 1242, 299-311 (1958).

Consideration is given to the impact parameter form of the Born approximation and of the perturbed rotating atom (pRA) approximation (i.e. the first-order approximation to which the perturbed stationary state, or PSS, approximation tends). Calculations are carried out on the excitation of normal hydrogen atoms to the 2s or 2p states in encounters with protons and other normal hydrogen atoms. The results obtained provide some information on the range of validity of the Born approximation. The impact-parameter treatment corresponding to a simplified version of the second Born approximation is given and discussed. Attention is drawn to the fact that for certain transitions the pRA approximation fails seriously when the encounter is very close. A.

MOLECULES

539.19 : 532.7 : 534.23

MOLECULAR RELAXATION PROCESSES IN LIQUIDS.
See Abstr. 4803

539.19

5442. INTERACTION POTENTIAL BETWEEN A MERCURY ATOM AND AN ARGON ATOM. S.Łegowski.
Bull. Acad. Polon. Sci. Sér. math astron. phys., Vol. 6, No. 2, 127-30 (1958).

The disposable parameters of the 6,12 Lennard-Jones' potential for the ground and $\Omega = 1$ excited state of HgA are determined from the thermodynamic properties of A_g and the spectroscopic properties of Hg_2. The resulting potentials are plotted. R.W.Nicholls

539.19

5443. DISSOCIATION PROCESSES IN OXYGEN ABOVE 1750 A.
P.G.Wilkinson and R.S.Mulliken.
Astrophys. J., Vol. 125, No. 2, 594-600 (March, 1957).

New photographs of the Schumann–Runge ($B\,^3\Sigma_u^- \leftarrow X\,^3\Sigma_g^-$) absorption bands of the oxygen molecule were taken in the third order of a 21-foot vacuum spectrograph at a dispersion of 0.4 A/mm. These photographs show a well-defined rotational line broadening in the 12-0 band which is not present in the 13-0 and following bands nearer the dissociation limit. This can be explained by a predissociation of the $B\,^3\Sigma_u^-$ state by a repulsive $^3\Pi_u$ state, as proposed by Flory, but intersecting the left limb of the $B\,^3\Sigma_u^-$ potential curve (and not the right limb). It is concluded that the photochemical dissociation of oxygen in the 1750-1850 A region involves this predissociation as well as direct dissociation by the transition from $X\,^3\Sigma_g^-$ to $^3\Pi_u$. It is shown that this latter transition is associated with observable continuous absorption of appreciable intensity and probably is the more important photochemical primary process above 1750 A. A.

539.19

5444. ON THE ORIGIN OF INTERACTION TERMS CHARACTERIZING MOLECULAR VIBRATIONS.
L.Burnelle and J.Duchesne.

Bull. Acad. Roy. Belgique Cl. Sci., Vol. 44, No. 1, 17-27 (1958). In French.

A very general potential function was calculated for SbH_3, and compared to that obtained for NH_3 and AsH_3. The theory of cross terms was improved by the introduction of the lone pairs in the treatment of hybridization, and by the consideration of the effect of configuration interaction. The interaction between non-bonded atoms was studied in mercuric halides, and a potential curve with a maximum was found, which is similar to that obtained previously for other linear molecules. A.

539.19

5445. CRITICAL STUDY OF VIBRONIC INTERACTION CALCULATIONS. A.D.Liehr.
Canad. J. Phys., Vol. 35, No. 9, 1123-32 (Sept., 1957).

A detailed study of the published non-empirical and semi-empirical calculations of vibronic (vibrational—electronic) interactions in the $^1B_{1u}$ and $^1B_{2u}$ states of benzene is carried out. It is found that, in all but the most detailed non-empirical theory of vibronic interactions, the Goeppert—Mayer and Sklar (1938) benzene electronic wave-functions are too crude to adequately describe such interactions. Also, it is shown that the previously proposed semi-empirical theories of vibronic interactions are derivable from the more exact theory of Liehr and Moffitt only with the aid of rather "herculean" assumptions. A.

539.19 : 535.333 : 537.525

ROTATIONAL TEMPERATURES OF HYDROXYL AND NITROGEN. See Abstr. 5026

539.19

5446. AN ELECTRIC QUADRUPOLE ELECTRONIC BAND SYSTEM IN MOLECULAR NITROGEN.
P.G.Wilkinson and R.S.Mulliken.
Astrophys. J., Vol. 126, No. 1, 10-13 (July, 1957).

It is shown that certain weak absorption lines observed on high-resolution photographs of the Lyman—Birge—Hopfield bands of nitrogen are members of S and O branches ($\Delta J = \pm 2$) and must therefore belong to an electric quadrupole electronic transition. This is the first known example of an electric quadrupole transition in the electronic spectra of molecules. The familiar Q, R, and P branches ($\Delta J = 0, \pm 1$) of the L.B.H. bands must then also be at least partly electric quadrupole and not just magnetic dipole, as currently supposed. It is shown by an approximate treatment that the electric quadrupole contribution to their intensity is perhaps about 15% of the total. The interpretation of the present observations removes all possible doubt concerning the assignment of the L.B.H. bands as a $^1\Pi_g - {}^1\Sigma_g^+$ transition. A.

539.19 : 539.14

5447. THE ELECTRIC FIELD GRADIENT IN THE HYDROCYANIC ACID MOLECULE AND THE DETERMINATION OF THE QUADRUPOLE MOMENT OF N^{14}. A.Bassompierre.
Ann. Phys. (Paris), Sér. 13, Vol. 2, No. 9-10, 676-713 (Sept.-Oct., 1957). In French.

Theoretical thesis describing in detail the Roothaan-type calculations on HCN, leading to an estimate of the field gradient at the N nucleus, which were briefly reported in Abstr. 2058, 3971 (1955). The quadrupole moment of N^{14} is given as $+0.0071 \times 10^{-24}$ cm^2. [Abstr. 3971/1955 quotes this value wrongly as 0.00071×10^{-24} cm^2]. J.Hawgood

539.19

5448. CONSIDERATION OF THE ELECTRON CORRELATIONS IN QUANTUM CHEMISTRY. K.Artmann.
Z. Phys., Vol. 149, No. 3, 299-310 (1957). In German.

Using the LiH molecule as an example, it is shown that in the calculation of molecular energies, instead of starting by employing antisymmetric products of one-electron eigenfunctions as approximate eigenfunctions of the whole atom, it is both simpler and more accurate to operate with the fully correct (unknown) eigenfunction, as long as possible, and approximate only at the last stage of the calculation. This enables the electron correlations in the atoms to be taken into account. M.J.Kearsley

539.19

5449. PARAMAGNETIC RESONANCE. J.H.E.Griffiths.
Disc. Faraday Soc., No. 19, 106-11 (1955).

A brief description is presented of this branch of spectroscopy and of the theory of the spectra observed in the transition and rare earth compounds, with the emphasis on those features which are of interest to chemistry. A.

539.19

5450. COUPLING OF NUCLEAR SPINS IN MOLECULES.
D.W.Posener.
Austral. J. Phys., Vol. 11, No. 1, 1-17 (March, 1958).

The theory of quadrupole, magnetic dipole, and dipole—dipole interactions of nuclear spins with molecular rotation is generalized for any number of nuclear spins in any free molecule which has no resultant electronic angular momentum. Calculation of the matrix elements of the Hamiltonian is discussed in detail, and the cases of one and two nuclear spins are dealt with explicitly. A.

539.19

5451. NUCLEAR QUADRUPOLE RESONANCE IN SOLIDS.
H.G.Dehmelt.
Disc. Faraday Soc., No. 19, 263-74 (1955).

539.19

5452. PROTON MAGNETIC RESONANCE IN CHAIN POLYMERS.
A.Odajima, J.Sohma and M.Koike.
J. Phys. Soc. Japan, Vol. 12, No. 3, 272-82 (March, 1957).

The experimental second moments of the absorption lines in the glassy state are compared with the calculated ones for the model of $(-CH_2.CHX-)_n$ type. The temperature variations of the line-widths were observed from room temperature to about 160°C. For PMMA and polystyrene having large side chains, the line-widths were found to narrow in two steps as temperature was raised. The first step of narrowing occurred in the neighbourhood of the glassy transition temperature T_g and is assigned to the onset of "hindered rotation" of the side chain. The second step of rapid narrowing started at the higher temperature than T_g and is assigned to the "segmental rotation" of the main chain. In contrast with these cases, the line-width transition of PVC and of PVAc occurred in a single step narrowing at the higher temperature than T_g which is assigned to the onset of the segmental motion. A.

539.19

5453. QUADRUPOLE COUPLINGS, DIPOLE MOMENTS AND THE CHEMICAL BOND. W.Gordy.
Disc. Faraday Soc., No. 19, 14-29 (1955).

539.19

5454. INVESTIGATION OF THE HYDROGEN BOND BY SPECTROSCOPIC METHODS. V.I.Malyshev.
Uspekhi fiz. Nauk., Vol. 63, No. 2, 323-53 (1957). In Russian.

A comprehensive review of the subject, designed also to focus attention upon the late G.S.Landsberg's contributions in the field, covering: effect of temperature and density on the vibration of O—H groups, the study of the H-bond in crystals, investigation of the H-bond by solution studies, determination of the heat of formation of an H-bond by spectroscopic methods, study of the process of condensation of water vapour. 43 references. C.R.S.Manders

539.19 : 538.222 : 537.226.1

ELECTROMAGNETIC PROPERTIES OF COMPRESSED GAS AND INTERMOLECULAR FORCES. See Abstr. 4941

539.19

5455. THEORY OF THE PARA—ORTHO CONVERSION IN SOLID DEUTERIUM. K.Motizuki.
J. Phys. Soc. Japan, Vol. 12, No. 2, 163-70 (Feb., 1957).

The rate of conversion is calculated taking two types of interactions, i.e., the magnetic dipole—dipole interaction between D_2 molecules and the coupling between the nuclear quadrupole moments of one D_2 molecule and the total quadrupole moment of the other molecule. It is found that both interactions make about the same contribution to the para—ortho conversion if only interactions among para molecules are taken into account. However, the ortho molecules with I = 2 also interact magnetically with para molecules and convert them into ortho molecules. The calculated conversion rate due to the para—para interactions is found to be 0.01% per hour times c^2, where c is the para concentration, while that due to the para—ortho interaction to be 0.01% per hour times c(1 −c), so that the c^2 terms eventually cancel each other, leaving a total conversion rate which is proportional to c. A.

539.19 : 535.333

5456. EXCITATION AND DISSOCIATION OF HYDROGEN BY AN ELECTRON SWARM. S.J.B.Corrigan and A.von Engel.
Proc. Roy. Soc. A, Vol. 245, No. 1242, 335-51 (1958).

Electrons moving in a uniform electric field ionize and excite gas molecules and, for feeble swarm currents, are known to multiply exponentially with distance. The rate of quantum production can therefore be expressed by an excitation coefficient analogous to Townsend's ionization coefficient. Excitation rates must be known

to calculate secondary effects by photoelectric emission from a cathode. A novel method of intensity measurements by counting quanta of vacuum u.v. radiation was developed, using a fluorescent converter, photomultiplier and scaler, to obtain the absolute magnitude of the excitation coefficient as a function of the electric field. The absolute intensity of the radiation was found by means of a photochemical reaction of known quantum efficiency. With electron currents up to 10^{-8} A it was shown that the emitted flux of u.v. quanta was proportional to the current and varied exponentially with distance from the cathode, in agreement with theory. The rate of dissociation of molecular hydrogen in an electrodeless discharge was measured by absorbing the atomic hydrogen formed and observing the rate of decrease of gas pressure. From this and electric data a dissociation coefficient was calculated showing that dissociation losses account for a large part of the energy balance. It seems that dissociation proceeds principally by electronic excitation from the ground state $1\,^1\Sigma_g$ to the lowest repulsive state $1\,^3\Sigma_u$. An average cross-section of $0.2\pi a_0^2$ was obtained for this transition in moderate electric fields. A.

SOLID-STATE PHYSICS

539.2

5457. ROTATIONAL LATTICE VIBRATION IN COMPLEX CRYSTALS. I. VIBRATIONAL MODES AND SPECIFIC HEAT.
S.Asano and Y.Tomishima.
J. Phys. Soc. Japan, Vol. 12, No. 4, 346-54 (April, 1957).

In complex crystals which contain groups of atoms bonded strongly with each other such as anionic radicals, complex ions and hydrated cations, low-frequency rotational vibrations of these groups of atoms may be expected to exist in addition to low-frequency translational vibrations, as in the case of ideal molecular crystals. By using a one-dimensional lattice, the modes of these vibrations are analysed. According to the results obtained, it is concluded that new additional modes appear, related to the rotational vibrations of the groups of atoms, and they may be classified, in general, into the optical and acoustical branches just as in the case of the translational vibrations. In addition, the effects of the introduction of these new modes upon the specific heat at low temperatures are investigated, by using the results of the analysis for the one-dimensional lattice. A.

539.2

5458. ROTATIONAL LATTICE VIBRATION IN COMPLEX CRYSTALS. II. VIBRATIONAL MODES IN OPTICAL BRANCHES AND INTERACTION WITH A CONDUCTION ELECTRON.
S.Asano and Y.Tomishima.
J. Phys. Soc. Japan, Vol. 12, No. 8, 890-9 (Aug., 1957).

Under the assumption that the anionic radical may be regarded as a rigid symmetric rotor, both the translational and the rotational lattice vibrations in the optical branches, which may be excited in isotropic complex crystals, are described on a macroscopic basis. By using the results obtained, the relative magnitudes of the mechanical and the radiative energy densities in the crystal are discussed for transverse vibrational modes. In addition, the interaction of a conduction electron with the rotational lattice vibration is investigated on the standpoint that the radiation field serves as a medium of the interaction. A.

539.2

5459. ROTATIONAL LATTICE VIBRATION IN COMPLEX CRYSTALS. III. VIBRATIONAL FREQUENCIES IN CUBIC $NaClO_4$ CRYSTALS. S.Asano and Y.Tomishima.
J. phys. Soc. Japan, Vol. 12, No. 8, 900-8 (Aug., 1957).

The frequencies of the translational and rotational vibrations (in optical branches) in the cubic $NaClO_4$ crystal, which is one of the complex crystals with simplest structure, are expressed in terms of the force constants of the interionic forces. The expression obtained with respect to the translational vibration is similar to that in the case of isotropic simple crystals, which is already known. Furthermore, by assuming reasonable values for these force constants, the orders of magnitudes of the both frequencies are estimated and compared with one another. The comparison shows that the both frequencies are nearly of the same order of magnitude. A.

539.2

5460. CHARACTERISTIC FREQUENCIES AND AMPLITUDES OF FREE NORMAL OSCILLATIONS IN KCl CRYSTALS. T.I.Kucher.
Zh. eksper. teor. Fiz., Vol. 32, No. 3, 498-505 (1957). In Russian.
English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 3, 418-25 (Oct., 1957).

Results of a calculation of the characteristic frequencies and amplitudes of free normal oscillations of the ions of a KCl crystal are presented. These calculations are carried out for values of the wave vector k which uniformly cover the cell of the reciprocal lattice by 729 points, with polarization deformation of the electron shells of the ions taken into account. A comparison is made with the results obtained by other authors. A.

539.2 : 538.566.2

ELECTROMAGNETIC WAVES IN A CRYSTAL IN WHICH EXCITONS ARE PRODUCED. See Abstr. 5151

539.2

5461. ELECTRICAL, OPTICAL AND ELASTIC PROPERTIES OF DIAMOND-TYPE CRYSTALS. I. V.S.Mashkevich and K.B.Tolpygo.
Zh. éksper. teor. Fiz., Vol. 32, No. 3, 520-5 (1957). In Russian.
English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 3, 435-9 (Oct., 1957).

The energy of a homopolar crystal is expressed as a function of the displacements and of the dipole moments of the atoms. By means of a variational method, the relation between the displacements and the deformation of the electronic shells of the atoms is established and equations of motion are presented in which the displacements and dipole moment of the atoms play the role of generalized coordinates. A.

539.2

5462. ELECTRICAL, OPTICAL, AND ELASTIC PROPERTIES OF DIAMOND-TYPE CRYSTALS. II. LATTICE VIBRATIONS WITH CALCULATION OF ATOMIC DIPOLE MOMENTS. V.S.Mashkevich.
Zh. éksper. teor. Fiz., Vol. 32, No. 4, 866-73 (1957). In Russian.
English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 4, 707-13 (Nov., 1957).

The equations of motion corresponding to the crystal energy, deduced previously in Pt I (see preceding abstract), are considered. The vibration spectrum for long waves is investigated. A qualitative study is being made of the possibility of infrared absorption by the lattice vibrations and of birefringence and interaction between the conductivity electrons and lattice vibrations. A.

539.2

5463. NORMAL VIBRATIONS OF GERMANIUM BY NEUTRON SPECTROMETRY. B.N.Brockhouse and P.K.Iyengar.
Phys. Rev., Vol. 108, No. 3, 894-5 (Nov. 1, 1957).

The frequency and the propagation vector were determined from the measured energy distribution. Results are found to diverge from the calculated curve using first-neighbour interactions only (Hsieh, Abstr. 4773/1954). Good agreement is found with infrared absorption measurements of Macfarlane et al. (see abstract following). J.Adam

539.2 : 535.375.5 : 535.343.9

LATTICE AND ION VIBRATIONS IN $CaCO_3$ AND $BaSO_4$. See Abstr. 4881

539.2 : 535.345

5464. FINE STRUCTURE IN THE ABSORPTION-EDGE SPECTRUM of Ge.
G.G.Macfarlane, T.P.McLean, J.E.Quarrington and V.Roberts.
Phys. Rev., Vol. 108, No. 6, 1377-83 (Dec. 15, 1957).

Measurements of the absorption spectrum of Ge, made with high resolution, near the main absorption edge at various temperatures between 4.2°K and 291°K revealed a fine structure in the absorption on the long-wavelength side of this edge. This structure has been analysed and can be interpreted in terms of indirect transitions involving phonons with energies corresponding to temperatures of 90°K and 320°K. The initial energy dependence of the components of the absorption coefficient associated with the 320°K phonons is interpreted as being due to the formation of excitons with a binding energy 0.005 eV. The form of the corresponding spectrum of photoconductivity also indicates that excitons are being produced. Using data on intrinsic carrier density and the temperature dependence of the energy gap for band-to-band transitions, a value of 4 is found for the number of conduction-band minima in Ge and an increase of about 20% in the combined density-of-states effective mass as the temperature increases from zero up to room temperature. 90°K and 320°K therefore correspond to the energies of phonons at the edge of the Brillouin zone in the <111> direction; these are shown to be acoustical phonons. These energies are lower than the corresponding values calculated from a Smith-type model for the vibrations of the Ge lattice. However, they are more consistent with the known Debye temperature and far infrared absorption of Ge than the calculated values. A.

539.2 : 539.32

VARIATION OF SHEAR STRENGTH WITH ATOMIC NUMBER. See Abstr. 4473

539.2

5465. LOCALIZED ELECTRONS IN BODY-CENTRED CUBIC METALS. J.S.Griffith and L.E.Orgel.
Nature (London), Vol. 181, 170-2 (Jan. 18, 1958).

Experimental evidence is presented for Griffith's suggestion (Journal of Inorganic and Nuclear Chemistry, Vol. 3, 15, 1956) that in b.c.c. transition metals the valence orbitals on a given atom fall into two classes, bonding and localized. Denoting the number of bonding and localized orbitals by m and n respectively, hypothetical configurations $b^m l^n$ are assigned to the b.c.c. metals of the first transition series. Evidence for these configurations is derived from magnetic properties, X-ray results on the spatial distribution of electrons, and soft X-ray spectra. Reasons are suggested for the fact that only iron of the group VIII metals forms a b.c.c. structure.
D.M.Edwards

539.2 : 539.12

POSITRON ANNIHILATION IN THE NOBLE METALS. See Abstr. 5190

539.2 : 534.23

5466. ELECTRON RESONANCES WITH ULTRASONIC WAVES IN COPPER. R.W.Morse, H.V.Bohm and J.D.Gavenda.
Phys. Rev., Vol. 109, No. 4, 1394-6 (Feb. 15, 1958).

Reports measurements of attenuation α in polycrystalline Cu below 4° K, at frequencies between 10 and 52 Mc/s and in transverse magnetic fields H up to 11 kG. Peaks in α are found at the same values of H for both longitudinal waves and transverse waves polarized perpendicular to H; for transverse waves polarized parallel to H, the positions of peaks and troughs in $\alpha(H)$ are interchanged. An explanation for this is proposed. From the spacing of the peaks, a value is derived for the momentum of the electrons at the Fermi surface; using a free-electron model, this value corresponds to 1.02 conduction electrons per atom.
R.G.Chambers

539.2 : 534.23

THE ABSORPTION OF VERY HIGH FREQUENCY SOUND IN DIELECTRIC SOLIDS. See Abstr. 4804

539.2

5467. ADIABATIC vs. BLOCH APPROXIMATION IN LATTICE SCATTERING OF ELECTRONS. B.Goodman.
Phys. Rev., Vol. 110, No. 4, 888-90 (May 15, 1958).

The time dependence of an electron–phonon system described by means of Born–Oppenheimer states is shown to be the same to first order in the coupling as the usual Bloch theory. A.

539.2

5468. ELECTRON MOMENTUM DISTRIBUTIONS IN SINGLE-CRYSTAL Cd. L.G.Lang and N.C.Hien.
Phys. Rev., Vol. 110, No. 5, 1062 (June 1, 1958).

The momentum distribution (distribution in p_z) of electrons in single-crystal Cd was observed through measurement of the angular correlation of annihilation radiation. An anisotropy of approximately 1% was detected, the distribution along the c axis being broader than that perpendicular to the c axis. A.

539.2

5469. THE THEORY OF TRANSPORT PHENOMENA.
M.I.Klinger.
Zh. tekh. Fiz., Vol. 27, No. 12, 2780-3 (1957). In Russian.

The use of the equations of motion of the density matrix to derive directly a closed formal expression for the electrical conductivity of a metal, is extended to give similar expression for the thermo-e.m.f., Peltier coefficient and thermal conductivity.
S.F.Edwards

539.2

5470. AN EXTENSION OF THE GENERAL VARIATIONAL PRINCIPLE OF TRANSPORT THEORY. F.Garcia Moliner and S.Simons.
Proc. Cambridge Phil. Soc., Vol. 53, Pt 4, 848-55 (Sept., 1957).

A variational principle is obtained for the Boltzmann transport equation for conduction electrons in crystal in the presence of a magnetic field and modified by boundaries, when the standard formulation of Kohler (see Abstr. 3962/1949 and 960/1950) breaks down because of the lack of microscopic reversibility. The connection with entropy production is discussed. A.

539.2

5471. BAND STRUCTURE OF THE POLARON ENERGY SPECTRUM. M.Sh.Giterman and K.B.Tolpygo.
Zh. éksper. teor. Fiz., Vol. 32, No. 4, 874-82 (1957). In Russian.
English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 4, 713-19 (Nov., 1957).

Using the macroscopic treatment of the polaron as the zeroth approximation, the periodic potential of a crystal and the periodic variation of its polarizability with variations in the position of the polaron centre of gravity are calculated in the first approximation. Dependence of the energy of a crystal with a polaron in the position of the polaron's centre of gravity is determined, and it is found possible to treat polaron motion as the motion of a particle with the polaron mass M in a field with a periodic potential. Widths and spacings of the lowest forbidden and allowed energy bands are found. A numerical calculation is performed for NaCl, KCl, KBr, and KI.
A.

539.2

5472. DIELECTRIC ANOMALIES AND CYCLOTRON ABSORPTION IN THE INFRARED: OBSERVATIONS ON BISMUTH.
W.S.Boyle, A.D.Brailsford and J.K.Galt.
Phys. Rev., Vol. 109, No. 4, 1396-8 (Feb. 15, 1958).

If the total complex conductivity of a metal is written $\sigma_1 - i(\sigma_2 - \omega\epsilon/4\pi)$, where ϵ is the dielectric constant, a "dielectric anomaly" occurs when $\sigma_2 = \omega\epsilon/4\pi$. It is pointed out that $\sigma_2(\omega)$ can be varied by applying a magnetic field, thus shifting the frequency ω at which the anomaly occurs. The theory is given for free electrons, and compared with experimental results on Bi in the wavelength range 40-70 μ, in fields up to 25 kG. The results indicate $m^* \sim 10^{-2}\ m_0$, $\epsilon \sim 9$, and $N \sim 5 \times 10^{18}$ cm^{-3}, where N is the number of conduction electrons per cm^3.
R.G.Chambers

539.2

5473. THEORY OF CYCLOTRON RESONANCE IN METALS.
M.Ya.Azbel' and É.A.Kaner.
Zh. éksper. teor. Fiz., Vol. 32, No. 4, 896-914 (1957). In Russian.
English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 4, 730-44 (Nov., 1957).

Investigation of a new type of resonance, which takes place in metals located in a high-frequency electromagnetic field and a stationary magnetic field parallel to the surface of the metal, the frequency ω of the alternating field being a multiple of the cyclotron frequency $\Omega = eH/mc$. The shape of the resonance curve depends considerably on the electron dispersion law and permits one to determine from the experimental data the topology of the Fermi surface and find some of its concrete characteristics. The surface impedance of the metal was computed for an arbitrary direction of the stationary magnetic field relative to the surface. The analysis was performed on basis of the most general assumptions of the electron theory of metals (arbitrary law of dispersion and collision integral). It was proved that it is possible to introduce the mean free path time of the electrons under the conditions of an anomalous skin effect at arbitrary temperatures. A.

539.2

5474. PARAMAGNETIC ABSORPTION AT HIGH FREQUENCIES IN GADOLINIUM SALTS IN PARALLEL FIELDS. A.I.Kurushin.
Zh. éksper. teor. Fiz., Vol. 32, No. 4, 727-30 (1957). In Russian.
English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 4, 601-3 (Nov., 1957).

Measurements were carried out at room temperature on the dependence of paramagnetic absorption on the intensity of a stationary field parallel to a high frequency 9.377×10^9 c/s field. The experimental absorption curves are in good agreement with Shaposhnikov's spin absorption theory. This made is possible to determine the internal field constant and the isothermal spin relaxation time for several gadolinium salts, and to determine in absolute units the absorption coefficient of $Gd_2(SO_4)_3.8H_2O$ as a function of the intensity of the stationary field. A.

539.2 : 539.18

PARAMAGNETIC RESONANCE ABSORPTION IN Mn-ACTIVATED HEXAGONAL ZnS. See Abstr. 5427

539.2

5475. NUCLEAR QUADRUPOLE COUPLING CONSTANTS OF Li^7 IN LITHIUM COMPOUNDS. J.F.Hon and P.J.Bray.
Phys. Rev., Vol. 110, No. 3, 624-9 (May 1, 1958).

Quadrupolar splittings of the Li^7 nuclear magnetic resonance were detected and measured in powders of LiOH, $LiOH \cdot H_2O$, $LiNO_3$, $LiNO_3 \cdot 3H_2O$, $LiIO_3$, Li_3PO_4, Li_2TiO_3, and Li_2ZrO_3. The theoretical powder pattern for a nonvanishing asymmetry parameter, η, was checked by observations in spodumene, $LiAl(SiO_3)_2$, and applied in the analysis of several of the observed spectra. It was found necessary to shorten the Li^7 spin–lattice relaxation time, T_1, in most of the compounds before successful measurements could be made. A.

539.2 : 539.18

5476. THE MOLECULAR ORBITAL THEORY OF THE INTERACTION BETWEEN AN ATOM AND A CRYSTAL SURFACE. T.B.Grimley.
Proc. Phys. Soc., Vol. 72, Pt 1, 103-15 (July, 1958).

The LCAO method of finding approximate one-electron wavefunctions is applied to an atom and crystal in mutual interaction. The case of a hydrogen-like atom and a crystal whose valence electrons occupy a band of states derived, in the LCAO approximation, from a single state is discussed with the help of the simplifying assumptions of the tight-binding approximation. Formulae are derived for the wave-functions and energy levels of this system. If the interaction extends only over a group Ω of crystal atoms near the foreign atom then, depending on the values of the interaction parameters, there may be localized states associated with the foreign atom and the group Ω. The energies of these states lie outside the normal band (including any surface band) of crystal states and their existence allows for the formation of localized bonds between the atom and the crystal. A.

539.2

5477. THE SPLITTING OF ENERGY BANDS AND [APPEARANCE OF] LEVELS BETWEEN BANDS DUE TO DISPLACEMENT OF LATTICE-ATOMS IN SOLIDS. A.Haug and A.Schönhofer.
Z. Phys., Vol. 148, No. 4, 513-26 (1957). In German.

A calculation based on a one-dimensional model with δ-function potentials which are displaced from equidistant lattice points. Spatially periodic displacements such as occur during lattice vibrations lead to splitting of the energy bands and a diminution in the original energy-gaps. Displacement of a single δ-function leaves the energy-spectrum undisturbed except for the appearance in each energy-gap of two levels with localized wave-functions.

D.M.Edwards

539.2 : 538.245

5478. THE COOPERATIVE BEHAVIOUR OF A TWO-DIMENSIONAL DEFECT CRYSTAL. E.W.Elcock.
Proc. Cambridge Phil. Soc., Vol. 53, Pt 4, 863-9 (Sept., 1957).

The Ising model of a two-dimensional ferromagnetic crystal containing defects is considered. It is shown that the combinatorial method is particularly appropriate to the investigation of the two-dimensional defect crystal and how it may be readily modified to calculate the partition function for such a crystal. It is found that the cooperative behaviour of the infinite perfect crystal, as indicated by the occurrence of a logarithmic singularity in the specific heat as a function of temperature, is not destroyed in the defect crystal; the singularity persists, though at a progressively lower temperature as the density of defects is increased, until a high density of defects is reached. The value of this limiting density of defects, above which the cooperative behaviour is destroyed, is calculated. A.

539.2 : 537.311.31 : 539.217

5479. DEFECTS OF CRYSTAL STRUCTURE AND CERTAIN PROPERTIES OF METALS AND ALLOYS. I.Ya.Dekhtyar.
Uspekhi fiz. Nauk, Vol. 62, No. 2, 99-128 (1957). In Russian.

The paper considers distortions of atomic type only, such as vacancies, dislocating atoms and dislocations. The types of atomic distortion, their properties, and methods for determining the defect density of crystal structure are reviewed. The effect of defects of crystal structure upon electrical resistance and diffusion in metals and alloys is discussed. 78 references. C.R.S.Manders

539.2 : 537.311.33 : 621.315.59

ANISOTROPIC DIFFUSION LENGTHS IN GERMANIUM AND SILICON CRYSTALS CONTAINING PARALLEL ARRAYS OF EDGE DISLOCATIONS. See Abstr. 4979

539.2 : 551.243

VOLTERRA'S DISLOCATIONS IN A SEMI-INFINITE ELASTIC MEDIUM. See Abstr. 4548

539.2

5480. HYDROGEN-LIKE MODEL OF IMPURITY LEVELS IN AN IONIC CRYSTAL: EFFECTIVE DIELECTRIC CONSTANT FOR THE EXCITED STATES. D.Curie.
C.R. Acad. Sci. (Paris), Vol. 246, No. 14, 2116-19 (April 9, 1958). In French.

539.2 : 539.14

5481. A STUDY OF THE BORON SITES IN COLEMANITE, $CaB_3O_4(OH)_3.H_2O$. F.Holuj and H.E.Petch.
Canad. J. Phys., Vol. 36, No. 1, 145-7 (Jan., 1958).

Nuclear magnetic resonance of B^{11} in colemanite was observed at room temperature, from which the quadrupole coupling constants are deduced for different boron sites, and deductions are made about the crystal structure. Measurements below the ferroelectric transition temperature (−2.5°C) indicate that the symmetry of the crystal changes from that of point group 2/m to 2 as it is cooled through the transition. J.M.Baker

539.2

5482. ELECTRONIC STATES OF THE F-CENTER IN LITHIUM FLUORIDE. I. T.Kojima.
J. Phys. Soc. Japan, Vol. 12, No. 8, 908-18 (Aug., 1957).

The electronic states are theoretically investigated taking account of the detailed atomic structure of the crystal. The Hamiltonian of an F-centre including polarization effects is presented. The polarizabilities of the ions in the crystal are determined from the static and high-frequency dielectric constants and the reststrahl frequency. Approximate eigenfunctions and energy levels are calculated with the use of variational wave-functions comprising linear combinations of the 2s and 2p atomic functions on the six lithium ions adjacent to the missing negative-ion site. For both the ground and excited states, the resulting wave-functions have larger coefficients of the 2p functions than those of the 2s functions. The first optical excitation energy is obtained to be somewhat smaller than the experimental value; possible sources of this discrepancy are discussed. The g-factor of the F-centre is also computed.

A.

539.2

5483. ELECTRONIC STATES OF THE F-CENTER IN LITHIUM FLUORIDE. II. T.Kojima.
J. Phys. Soc. Japan, Vol. 12, No. 8, 918-28 (Aug., 1957).

The electronic structure is investigated by making use of a variational wave-function for the trapped electron which is orthogonal to all the ion-core functions. The variational parameters are so determined as to minimize the total energy of the whole crystal, including exchange interactions, polarization effects and van der Waals interactions. The equilibrium positions of the surrounding ions and the ion-core dipoles are determined in a self-consistent manner with the F-centre wave-functions. The resulting wave-function shows correct oscillatory behaviour around each nucleus. The calculated first optical excitation energy is in excellent agreement with experiment. The associated oscillator strength is also evaluated. The line-width of the electron spin resonance is computed, yielding a value twice as large as the experimental value. A source of this discrepancy and other sources of errors which might have affected the energy levels are examined. A.

539.2

5484. ON THE PHOTOCHEMICAL TRANSFORMATION OF COLOUR CENTRES IN HEATED ALKALI-HALIDE CRYSTALS. A.A.Shatalov.
Optika i Spektrosk., Vol. 3, No. 6, 610-18 (1957). In Russian.

General confirmation and extension of earlier work (Abstr. 9041/1956) showing that, at temperatures 270-300°C, F-bands disappear and are replaced by bell-shaped X-bands displaced by about 0.5 eV towards longer wavelengths. General temperature dependence of both types of bands is discussed and their frequency-maximum (ν_m) relationship to the lattice constant (d) in KCl, NaCl, KBr, KI and LiF considered. The relationship $\nu_m d^3 = \text{const.}$ seems to be less accurately obeyed for X-bands. The state of aggregation of the centres giving rise to the bands is briefly considered. L.Bovey

539.2 : 539.14

5485. ELECTRON SPIN RESONANCE OF F CENTERS IN MAGNESIUM OXIDE; CONFIRMATION OF THE SPIN OF MAGNESIUM-25. J.E.Wertz, P.Auzins, R.A.Weeks and R.H.Silsbee.
Phys. Rev., Vol. 107, No. 6, 1535-7 (Sept. 15, 1957).

An electron spin resonance (E.S.R.) spectrum induced in magnesium oxide crystals by pile irradiation is interpreted as arising from F-centres. After an oxide ion is displaced from its normal position by neutrons, an electron donated by ever-present divalent impurities may become trapped at the vacancy. Those centres having only Mg^{24} and Mg^{26} neighbours give a single E.S.R. line with g = 2.0023, while those with one or more Mg^{25} neighbours give hyperfine patterns corresponding to the nuclear spin value of $\frac{5}{2}$. The magnitudes of the isotropic and anisotropic parts of the hyperfine interaction show strong localization of the electron in the vacancy. A.

539.2

5486. HYPERFINE INTERACTIONS IN F CENTERS. W.E.Blumberg and T.P.Das.
Phys. Rev., Vol. 110, No. 3, 647-51 (May 1, 1958).

A method of calculating the magnetic and quadrupole hyperfine interactions of an electron with neighbouring and next neighbouring nuclei in the vacancy model of the F centre and the change in its spectroscopic splitting factor are presented and carried out in the case of KCl. Two wave-functions are used for the F electron in this calculation, one obtained from a point-charge treatment of the crystal lattice and the other from a square-well approximation of the vacancy. The results are shown to be nearly the same for these two widely different approximations and are found to be in good qualitative agreement and even fair quantitative agreement with experimental data of Feher and Kip et al. A.

539.2

5487. DICHROISM OF THE F AND M BANDS IN KCl.
H.Kanzaki.
Phys. Rev., Vol. 110, No. 5, 1063-8 (June 1, 1958).

The dichroism of the F and M absorption bands that can be produced by optical bleaching of the F band with polarized light at 87°K is critically dependent on the concentrations of F and M centres. The changes in half-widths and peak positions of the F and M bands that accompany the development of dichroism suggest that the F-band dichroism is due to a spatial association of F and M centres. It is probable that an excited F centre can transfer energy to a neighbouring M centre. Dichroism of the F and M bands can be produced at room temperature by optical bleaching of either band with polarized radiation. A.

539.2

5488. COLOR CENTERS IN KCl CONTAINING Li^+ OR Na^+.
M.Ishiguro and E.Sugioka.
Phys. Rev., Vol. 110, No. 5, 1070 (June 1, 1958).

A new absorption band has been discovered in KCl crystals containing Li^+ or Na^+ ions. The conditions for formation of this band and its behaviour during thermal or optical bleaching indicate that it is due to a centre similar to the B centre of crystals containing Ag^+. The model of the B centre proposed by Etzel and Schulman (Abstr. 11550/1954) is assumed and a mechanism for its formation is proposed. A.

539.2 : 535.347

5489. DICHROISM OF THE Z_2 BAND IN NaCl.
G.Remaut and W.Dekeyser.
Physica, Vol. 24, No. 1, 20-2 (Jan., 1958).

Experiments are reported which test the theory of Seitz that the Z_2 band in NaCl with divalent impurities is due to a divalent ion and a neutral pair of vacancies giving a centre with two different lattice orientations. Experiments on bleaching in the Z_2 band with light polarized in different crystal directions indicate dichroic behaviour. From these experiments interaction between Z_2 centres of both orientations in the lattice occurs. G.F.J.Garlick

539.21

5490. NEUTRON IRRADIATION EFFECTS IN BOROSILICATE GLASS AND THEIR DETECTION BY ULTRASONIC ATTENUATION AND VELOCITY MEASUREMENTS.
R.Truell, J.deKlerk and P.W.Levy.
J. appl. Phys., Vol. 29, No. 2, 225-6 (Feb., 1958).

Irradiation of under one hour duration in the Brookhaven reactor produces attenuation and velocity changes. After longer irradiations the glass samples invariably cracked and eventually fell to pieces. J.Adam

539.21 : 537.311.33

5491. THE EFFECT OF FAST-NEUTRON IRRADIATION ON RECOMBINATION OF ELECTRONS AND HOLES IN GERMANIUM CRYSTALS.
V.S.Vavilov, A.V.Spitsyn, L.S.Smirnov and M.V.Chukichev.
Zh. éksper. teor. Fiz., Vol. 32, No. 4, 702-5 (1957). In Russian.
English translation in: Soviet Physics — JETP (New York), Vol. 5, No. 4, 579-82 (Nov., 1957).

It is found that irradiation of germanium crystals with fast neutrons leads to an increase of the rate of volume recombination. The probability of recombination trapping of charge carriers by defects which appear as a result of irradiation is estimated. The strong effect of neutron irradiation on the lifetime of carriers can be used to record and measure integral fluxes of fast neutrons. A.

539.21

5492. ON THE ALTERATION OF THE STRUCTURE OF ORGANIC LAYERS BY ELECTRON BOMBARDMENT. A.Brockes.
Z. Phys., Vol. 149, No. 3, 353-69 (1957). In German.

Polystyrene and nitrocellulose layers, about 1 cm^2 in area and 10 μ in thickness, were bombarded in vacuo by 70 kV electrons, the dose ranging from 10^4 to 10^7 W sec/g. The resulting alterations in structure were investigated by studying the ultraviolet, infrared, and visible absorption spectra, together with changes in electrical conductivity and density. J.Thewlis

539.21 : 535.343

EFFECT OF NEUTRON IRRADIATION ON INFRARED ABSORPTION IN SILICON. See Abstr. 4878

STRUCTURE OF SOLIDS

539.217

5493. COEFFICIENT FOR SELF-DIFFUSION DETERMINED FROM THE RATE OF PRECIPITATION OF Cu IN Ge. P.Penning.
Phys. Rev., Vol. 110, No. 2, 586-7 (April 15, 1958).

Tweet's results (Abstr. 5670/1957) are used to obtain the coefficient of self-diffusion in Ge, a vacancy mechanism being assumed. D.M.Edwards

539.217

5494. MEASUREMENT OF THE DEPTH OF PENETRATION AND THE COEFFICIENT OF DIFFUSION OF A GAS IN A METAL.
A.M.Rodin and S.A.Kuchaĭ.
Pribory i tekh. Éksper., 1957, No. 4, 68-9. In Russian.

A one-dimensional diffusion equation is solved assuming that the coefficient of diffusion does not depend on the coordinates and the gas concentration, and subject to simple boundary conditions (the special case of a disk). S.Chomet

539.217 : 537.311.33 : 621.315.59

SURFACE CONCENTRATION OF DIFFUSED LAYERS IN SILICON. See Abstr. 4990

539.217 : 537.311.31 : 539.2

EFFECTS OF CRYSTAL DEFECTS ON DIFFUSION IN METALS AND ALLOYS. See Abstr. 5479

539.219 : 537.311.31

RESIDUAL ELECTRICAL RESISTANCE OF MULTICOMPONENT ORDERABLE ALLOYS. See Abstr. 4950

539.219 : 537.523

THE VALENCE STATE OF METALLIC LEAD. See Abstr. 5015

539.234 : 537.533.8

ELECTRON OPTICAL TRANSFER: A STUDY OF ELECTRON BOMBARDMENT OF SURFACES. See Abstr. 5056

ELASTICITY. STRENGTH. RHEOLOGY

539.32

5495. THE PROBLEM OF ELASTIC ANISOTROPY OF CUBIC CRYSTALS IN THE PLANE (h, k, l). S.E.Shtepan.
Kristallografiya, Vol. 2, No. 6, 776-7 (1957). In Russian.

The elastic constants at an arbitrary angle θ in the (h, k, l) plane are expressed in terms of the fundamental elastic constants, the angle θ and the indices h, k, l. R.F.S.Hearmon

539.32

5496. THERMO-ELASTIC BEHAVIOUR OF CUBIC CRYSTALS.
S.V.Subrahmanyam.
Proc. Indian Acad. Sci. A, Vol. 47, No. 1, 25-9 (Jan., 1958).

The results are given of measurements, using the composite piezoelectric oscillator method, of the temperature dependence of the elastic moduli of single crystals of KCl, KBr, LiF, NH_4Cl, FeS_2, Fe_2O_3, CaF_2 and PbS in the temperature range 30-300°C. H.J.H.Starks

539.371 : 539.374

5497. EXPERIMENTS TO INVESTIGATE KINETIC SOFTENING OF SINGLE CRYSTALS OF TlBr—TlI. V.R.Regel' and G.A.Dubov.
Kristallografiya, Vol. 2, No. 6, 756-9 (1957). In Russian.

See the preceding abstract. The degree of softening is obtained from a stress—relative extension curve on the original specimen compared with a similar curve obtained afterwards on the same specimen after a period of relaxation. The degree of softening is measured as a function of temperature and of length of the relaxation period. R.F.S.Hearmon

539.371 : 539.374

5498. THE PROBLEM OF A METHOD FOR TESTING SMALL SPECIMENS IN SHEAR AND STRESS RELAXATION.
G.A.Dubov and V.R.Regel'.
Kristallografiya, Vol. 2, No. 6, 746-55 (1957). In Russian.

The photoelectrooptical dynamometer (Dubov and Regel',

Zh. tekh. Fiz., Vol. 25, No. 14, 2542, 1955) is used to obtain curves of flow in shear and of stress relaxation for polymethylmethacrylate and single crystal TlBr–TlI. The effect of the ratio of height to diameter in the specimen is investigated, and the parameters of the curves in shear and extension are compared.

R.F.S.Hearmon

539.371 : 539.219.2

5499. DISLOCATIONS AND CRACKS IN ANISOTROPIC ELASTICITY. A.N.Stroh.
Phil. Mag. (Eighth Ser.), Vol. 3, 625-46 (June, 1958).

The solution of the elastic equations is considered for the case in which the state of the solid is independent of one of the three Cartesian coordinates. The stresses due to a dislocation, a wall of parallel dislocations, and a crack in an arbitrary non-uniform stress field are obtained. The results hold for the most general anisotropy in which no symmetry elements of the crystal are assumed. A.

539.374 : 539.2

5500. THE LATTICE EXPANSIONS OF PURE Cu WHEN PLASTICALLY DEFORMED, MEASURED WITH Co X-RAY RADIATION. C.O.Leiber and E.Macherauch.
Naturwissenschaften, Vol. 45, No. 2, 35 (1958). In German.

Measurements are described of the lattice expansions of pure Cu when subjected to a plastic deformation of 10%; the results do not conform to those expected from the theory of Greenough.

H.J.H.Starks

539.374

5501. YIELD PHENOMENA IN COPPER–ARSENIC ALLOYS. K.Schröder.
Proc. Phys. Soc., Vol. 72, Pt 1, 33-41 (July, 1958).

The occurrence of strain ageing in single crystals of arsenical copper (0.36% As) was established by simultaneous determinations of stress–strain curves and changes in electrical resistivity. During yielding the electrical resistance increased more rapidly than normally. The change in resistance during yielding is explained in terms of Cottrell's model of an impurity atmosphere around dislocations. A.

539.4.011.25

5502. RUPTURE PROPAGATION IN INHOMOGENEOUS SOLIDS: AN ELECTRON MICROSCOPIC STUDY OF RUBBER CONTAINING COLLOIDAL CARBON BLACK. E.H.Andrews and A.Walsh.
Proc. Phys. Soc., Vol. 72, Pt 1, 42-8 (July, 1958).

Replica electron microscopy of rupture surfaces was used to study the rupture process in solid "two-phase" systems obtained by dispersing colloidal carbon in rubber. Two parameters are introduced to characterize the surfaces; the total proportion of filler in the surface, and the proportion extracted by the gelatine first-stage replica. The latter quantity provides a measure of carbon-to-rubber adhesion in the rupture surface, whilst values obtained for the former quantity indicate that the rupture deviates strongly from a random plane through the material. The results, together with a correlation found between adhesion and tearing energy, may be largely explained in terms of the local concentrations of stress which occur at the particles of the dispersed phase. A.

539.4.016.2

5503. DISTORTED LAYERS IN SILICON PRODUCED BY GRINDING AND POLISHING. W.C.Dash.
J. appl. Phys., Vol. 29, No. 2, 228-5 (Feb., 1958).

Thin specimens bend when a major surface is abraded. The amount of bending was measured to within 4 sec of arc for Si specimens 0.05 cm thick, and by subsequent etching the average depth of damage for a smooth ground and optically polished surface was found to be 7000 and 150 A respectively. From estimates of the strain it was concluded that mechanical working of the surface at room temperature causes no deformation of the bulk. D.Haneman

539.42

5504. SOME EFFECTS OF ENVIRONMENT ON FRACTURE STRESS OF GERMANIUM.
P.Breidt,Jr, J.N.Hobstetter and W.C.Ellis.
J. appl. Phys., Vol. 29, No. 2, 226 (Feb., 1958).

Beams of germanium with 111 axes and 1.5 by 1.5 by 55 mm were subjected to 4-point loading while immersed in various etching media. The stress at fracture was determined from the load and the cross-section at fracture. Using various amounts of HF in HNO_3, the fracture stress increased with etching rate from the value of 7 kg/mm^2 characteristic of tests in air to reach a maximum of about 47 kg/mm^2 at an etching rate of 0.15 mm/hr, after which it fell rapidly to reach a nearly constant value about 3 times the strength in air. The enhanced strength occurred only when etching was actually going on or when the specimen was protected from air after etching. The enhancement was also found dependent on the nature of the etchant. A.C.Whiffin

PHYSICAL CHEMISTRY

PHASE EQUILIBRIUM. CHEMICAL REACTIONS

541.124 : 534.222.2

5505. SHOCK-INDUCED PHYSICAL AND CHEMICAL SURFACE CHANGES ON OXIDE POWDERS. R.W.Nicholls and W.H.Parkinson.
Canad. J. Phys., Vol. 36, No. 5, 625-7 (May, 1958).

A description is given of the colour changes occurring on the surface of powdered α-hematite (Fe_2O_3), litharge (PbO) and metatungstic acid ($H_2W_4O_{13}$) when subjected to transient high temperature (about 5700° K for 2 msec) in a shock tube. Fe_2O_3 changed from red to black; microscopic analysis showed the presence of black spherical inclusions about 10 μ in diameter, identified as Fe_3O_4 upon the ablated surface of the shocked grain. Similar changes in the other powders and the associated band spectra of the luminosities are described. H.J.H.Starks

ELECTROCHEMISTRY

541.13 : 669

5506. NEW APPROACH TO ELECTROLYTIC U.
L.W.Niedrach, B.E.Dearing and A.C.Schafer.
Nucleonics, Vol. 16, No. 1, 64-5 (Jan., 1958).

A design study for an electrolytic cell producing 1000 kg of uranium a day. The design is based on experimental measurements of the reduction of UO_2 with carbon electrodes in a bath consisting of a mixture of UF_4, 20; MgF_2, 40; BaF_2, 40 (mole %). A temperature of 1200° C and an anode current density of 20 A/in^2 is used. R.D.Smith

PHOTOCHEMISTRY. RADIATION CHEMISTRY

541.15 : 534.321.9

5507. SYNTHESIS OF AMMONIA AND CYANOGEN COMPOUNDS IN AN ULTRASONIC WAVE FIELD.
A.V.Sokol'skaya and I.E.El'piner.
Akust. Zh., Vol. 3, No. 3, 293-4 (1957). In Russian.

Distilled water was saturated with various gases (H_2, N_2, H_2 + + N_2, air) and subjected to ultrasonic radiation of 380 kc/s or 740 kc/s of intensity 6-7 W/cm^2 for periods of from 50 min up to 6 hours. Oxidation of nitrogen to nitric and nitrous oxides was observed, as well as reduction to ammonia. For water saturated with H_2 and N_2 and subjected to a six-hour irradiation the ammonia concentration may reach 12.5×10^{-6} g/cm^3. C.R.S.Manders

541.15

5508. RADIATION POLYMERIZATION MAKES STRONGER POLYSTYRENE. E.L.Colichman and R.F.Fish.
Nucleonics, Vol. 15, No. 10, 134-7 (Oct., 1957).

Polymerization of styrene with 0-10% divinyl-benzene as the co-polymerizing cross-linking agent at γ-doses of $1.0 - 3.8 \times 10^7$ r was studied at temperatures of 50-100° C. Hardness, tensile strength, and heat distortion temperatures were all considerably increased above those of thermally polymerized samples. R.D.Smith

541.15 : 539.21

5509. PRODUCTION OF COLLOIDAL SODIUM IN NaCl BY IONIZING RADIATION. W.D.Compton.
Phys. Rev., Vol. 107, No. 5, 1271-5 (Sept. 1, 1957).

A study was made of the coloration of synthetic and natural sodium chloride crystals with Co^{60} gamma-ray and 1.3 MeV electron

irradiations. These irradiations produced the colloid band, at 565 mμ, in the synthetic crystals but not in untreated natural crystals. Various thermal treatments were given the natural crystals prior to their coloration. It was found that either type of irradiation would produce colloids in crystals that had been heated at 700°C for at least 24 hours in an atmosphere containing hydroxyl ions. Colloids were produced in the untreated natural crystals by additive coloration. It was found that the characteristics of the colloids were the same whether they were produced by ionizing radiation or by additive coloration, with the exception of the role played by hydroxyl ions in the crystals coloured by ionizing radiation. A.

DISPERSIONS. COLLOIDS. ADSORPTION

541.182 : 534.321.9

STUDY ON THE SEPARATION OF EMULSIONS AND SUSPENSIONS BY THE USE OF ULTRASONICS. See Abstr. 4818

541.183

5510. ADSORPTION AND DIFFUSION OF HYDROGEN ON NICKEL. R.Wortman, R.Gomer and R.Lundy.
J. chem. Phys., Vol. 27, No. 5, 1099-107 (Nov., 1957).

The surface diffusion and adsorption of hydrogen on Ni field emitters was investigated by a technique previously used for similar studies of H and O diffusion on W. It was found that diffusion occurs with an activation energy of 7 ± 1 kcal in the chemisorbed layer, without the precipitation boundaries observed on W. This is believed to result from the inherent homogeneity of f.c.c. substrates, on which most adsorption sites seem equivalent. This is supported by the marked lacked of emission anisotropy of hydrogen-covered Ni field emitters. A field dependent transformation in the adsorbed film was found between 2° and 4°K and interpreted as a shift in the equilibrium between adsorbed H_2 molecules and the terminal fraction of adsorbed H atoms. The implications of this result for the mechanism of H_2—D_2 exchange are discussed. The activation energy of desorption at very low coverage is determined to be 46 ± 4 kcal from the temperature dependence of desorption rates. A.

541.183 : 539.16

5511. MOLECULAR SIEVES ADSORB IODINE-131 FROM AIR.
M.A.Wahlgren and W.W.Meinke.
Nucleonics, Vol. 15, No. 9, 156, 158, 160 (Sept., 1957).

Synthetic zeolite crystals contain a large number of holes interconnected by smaller pores. These normally contain water, but after the water has been driven off by heating, the crystals will readily adsorb other materials that can pass through the pores. With a pore size of about 5 A, iodine is strongly adsorbed and decontamination factors of up to 10^5 with an air flow of 1 ft^3/min were obtained from an experimental column. R.D.Smith

541.183.56

5512. NUCLEAR MAGNETIC RESONANCE OF METHANE ADSORBED IN TITANIUM DIOXIDE. N.Fuschillo and C.A.Renton.
Nature (London), Vol. 180, 1063-4 (Nov. 16, 1957).

The values for the adsorbed film are compared with those for bulk methane in the same temperature range, 10 to 90°K. At a monolayer coverage of 1.0 a line-width transition was encountered near the λ-point temperature of methane, 20.4°K. The properties of bulk methane are simulated when the thickness reaches four monolayers. S.J.Gregg

CHEMICAL ANALYSIS

545.82

5513. SPECTRAL ANALYSIS BY AN EVAPORATION METHOD. V. ANALYSIS OF PLUTONIUM BY THE METHOD OF EVAPORATION IN VACUO.
A.N.Zaĭdel', N.I.Kaliteevskiĭ, L.V.Lipis and V.M.Tarakanov.
Optika i Spectrosk., Vol. 3, No. 1,16-20 (1957). In Russian.

For previous work, see Optika i Spektrosk., Vol. 2, No. 1, 28 (1957) and Zhurnal Analiticheskoi Khimii, Vol. 12, 17 (1957). A preliminary account is given and precautions taken because of chemical toxicity and highly radioactive nature of Pu are outlined. Accuracy and reproducibility appear to be of the same order as those found with ThO_2 and 1-2 μg samples can be used. L.Bovey

545.827 : 621.315.59

5514. RADIOCHEMICAL ANALYSIS OF SILICON.
J.A.James and D.H.Richards.
J. Electronics and Control, Vol. 3, No. 5, 500-6 (Nov., 1957).

Results of radioactive analyses for some 12 elements are given for silicon from two sources. The results of segregation coefficient measurements using radiochemical methods are quoted for P, Fe, Co, W and Au. A.

CRYSTALLOGRAPHY

548.1 : 539.2

5515. POINT GROUPS OF CRYSTAL SYMMETRY AND THEIR INTERPRETATION. I.S.Zheludev.
Kristallografiya, Vol. 2, No. 6, 728-33 (1957). In Russian.

The effect on a cube is considered of influences represented by the following: pseudoscalar (e.g. twisting from all sides), polar tensor (e.g. extension), axial tensor (e.g. twisting), polar vector (e.g. electric polarization), and axial vector (e.g. rotation). It is shown that the 32 point groups of symmetry may be derived by applying these influences in various directions and in various combinations. Some of the point groups may be obtained in more than one way, which suggests the possibility that crystals belonging to a single point group may have different physical properties.

R.F.S.Hearmon

548.4 : 621.315.59

5516. THE CRYSTALLINE PERFECTION OF SOME SEMICONDUCTOR SINGLE CRYSTALS. R.L.Bell.
J. Electronics and Control, Vol. 3, No. 5, 487-93 (Nov., 1957).

Single crystals of germanium, silicon, indium antimonide and mercury telluride were examined by the Guinier–Tennevin X-ray technique. The degree of perfection as shown by the width of the focused Laue image was compared with the dislocation density as revealed by etch-pits. A.

548.5 : 539.219

5517. THE PROBLEM OF THE DIFFUSIONLESS CRYSTALLIZATION OF METALLIC ALLOYS. V.M.Glazov and V.N.Vigdorovich.
Dokl. Akad. Nauk SSSR, Vol. 118, No. 5, 924-7 (1958). In Russian.

From free energy considerations it is shown that, with sufficient supercooling, liquids in binary systems having limited solid solubility should crystallize without dendritic growth, a homogeneous solid being obtained without subsequent prolonged solid state diffusion. The degree of dendritic branching D for a given alloy should initially increase with increasing cooling rate R (which determines the amount of supercooling), but it should eventually fall to zero. D should also depend on the concentration of alloying element C: increasing C displacing the D–R curve to higher values of R for systems showing freezing point depression, the opposite being true for systems showing freezing point elevation. Microhardness measurements of Al alloys (with Cu, Si or Fe), cooled at up to ~ 400°C/sec, were used to check the theory, since microhardness and D should be closely related. Microhardness–cooling rate curves of the expected form were obtained. The preparation of homogeneous solids of specific composition (e.g. semiconductors) by rapid cooling is suggested.

C.H.L.Goodman

548.5

5518. THE GROWTH OF ALKALI HALIDE WHISKERS FROM SOLUTION. S.Amelinckx.
Physica, Vol. 24, No. 5, 390-2 (May, 1958).

Reproducible whiskers of NaCl, KCl and KBr can be grown by storing an aqueous solution in a thin cellophane bag; a beard of whiskers grows on the outside of the bag. The whiskers are bounded by cube faces and often have a large pyramidal base; a hollow channel sometimes extends along the whole axis. The whiskers are very plastic. Their growth mechanism is analysed.

A.B.Lidiard

548.52

5519. KINETICS OF CRYSTALLIZATION AT CONSTANT TEMPERATURE AND SUPERSATURATION. M.I.Kozlovskil.
Kristallografiya, Vol. 2, No. 6, 760-9 (1957). In Russian.

A method is described for growing crystals in solution under conditions of constant temperature and supersaturation, and for measuring the growth velocity of the faces without removing the crystal from solution. The kinetic equations of crystallization of Rochelle salt under constant-growth conditions are derived.

R.F.S.Hearmon

548.574

5520. ETCHING PATTERNS IN HIGH PURITY ZINC.
F.C.Frank and T.Vreeland.
Phil. Mag. (Eighth Ser.), Vol. 3, 419-21 (April, 1958).

Etch patterns obtained by Servi (Abstr. 1367/1958) are explicable in terms of Frank–Read sources. J.W.Menter

X-RAY CRYSTALLOGRAPHY

548.73/.74

X-RAY AND ELECTRON INVESTIGATION OF MATERIALS. See also under "Structure of solids". Decimal classification 539.26/.27

548.73

5521. X-RAY SCATTERING BY THERMAL AGITATION OF ATOMS IN A CRYSTAL. J.Laval.
Rev. mod. Phys., Vol. 30, No. 1, 222-7 (Jan., 1958).

A general mathematical treatment of the intensity of scattering is given. (See Abstr. 10651/1954). A.R.Stokes

548.735

5522. EFFECTS OF LAYER FAULTS IN DIAMOND STRUCTURES ON X-RAY DIFFRACTION PATTERNS. O.J.Guentert.
J. appl. Phys., Vol. 28, No. 12, 1515-16 (Dec., 1957).

It is shown that the theory of the effect of these faults is the same as for a simple face-centred cubic structure with stacking faults. A.R.Stokes

548.735.7

5523. THE EFFECT OF GRAIN BOUNDARIES ON THE X-RAY DIFFRACTION PATTERN. L.Hyvärinen.
Ann. Acad. Sci. Fennicae A VI, 1957, No. 1, 10 pp.

The intensity of X-ray diffraction from a crystal is considered in relationship to the nature of the crystal surface. The latter has no effect unless the crystals are small. J.Thewlis

548.736.1 : 539.26

5524. X-RAY SCATTERING BY SUBMICROSCOPIC DEFECTS AT EXTREMELY SMALL ANGLES. S.N.Zhurkov and A.I.Slutsker.
Zh. tekh. Fiz., Vol. 27, No. 6, 1392-4 (1957). In Russian.

An apparatus is described which is intended to increase the speed of measurement and discrimination against background; it uses a screening edge rather than collimating slits, and can be used down to angles of 1'. Results obtained on Al indicate the presence in deformed specimens of voids 10-200 A in diameter.

Metallurgical Abstracts

GEOPHYSICS

550.38 : 550.838

5525. THE EFFECT OF REMANENT MAGNETIZATION ON AEROMAGNETIC INTERPRETATION. D.J.Sutton and W.G.Mumme.
Austral. J. Phys., Vol. 10, No. 4, 547-57 (Dec., 1957).

The interpretation of aeromagnetic maps when the source may be approximated to a point dipole or line of dipoles is considered for the general case in which the dipole moment is not necessarily parallel to the earth's magnetic field. For the line of dipoles, it is shown that even in this general case the depth and location of the source can be found, and in addition the direction of the component of the dipole moment in a plane normal to the line source may be determined. If the Königsberger ratio for the rock constituting the source is large, this is approximately the direction of the remanent magnetization. Such information is important from a palaeomagnetic viewpoint. When the source approximates closely to a point dipole, it is not possible both to locate the source and to determine the direction of the dipole moment from an analysis of the aeromagnetic map. The solution of the problem requires further information.

A.

550.38 : 523.75

5526. THE EFFECT OF SOLAR FLARES ON THE GEOMAGNETIC FIELD. R.Pratap.
J. geophys. Res., Vol. 62, No. 4, 581-8 (Dec., 1957).

The dynamo equation is solved for a conductivity produced by solar-flare u.v. radiations from the sun. The crochet amplitudes in horizontal field components are then computed and compared with

observed results. It is found that fair agreement exists between the theoretical and experimental values only if the seat of the crochet current system is within a few kilometres of the current system producing the quiet-day solar variation. A.

550.38 : 538.314

DYNAMO THEORY OF THE EARTH'S MAGNETIC FIELD. See Abstr. 5134

550.385

5527. ON THE GEOMAGNETIC STORM EFFECT. C.O.Hines.
J. geophys. Res., Vol. 62, No. 3, 491-2 (Sept., 1957).

It is shown that the delay of 87 days, suggested by the "ring-current" hypothesis, is not an insuperable objection to this theory. J.M.Hough

550.385

5528. ELECTRICAL CONDUCTIVITY IN THE GEOMAGNETIC STORM EFFECT. E.N.Parker.
J. geophys. Res., Vol. 63, No. 2, 437-8 (June, 1958).

The suggestion of Hines (see preceding abstract), that a magnetic field due to a ring current may penetrate rapidly through the electrically conducting gas surrounding the earth because of the geomagnetic field, is shown to be not in accord with electromagnetic theory. J.M.Hough

550.385

5529. SUDDEN COMMENCEMENTS OF MAGNETIC STORMS AND ATMOSPHERIC DYNAMO ACTION. T.Obayashi and J.A.Jacobs.
J. geophys. Res., Vol. 62, No. 4, 589-616 (Dec., 1957).

A statistical investigation of world-wide, sudden commencements of magnetic storms was carried out using data from over 30 magnetic observatories distributed all over the world. An appreciable diurnal change in the amplitude of SC's was found, and the average electric current system for the Ds field shows conspicuous current concentrations in the polar regions. The pattern of this current system is similar to that caused by an electric doublet centered on the highly conducting region near the geomagnetic pole, and hence it is probable that the current system exists within the earth's atmosphere. On the other hand, the Dst field of Sc's seems more likely to be of extraterrestrial origin. An atmospheric dynamo theory was applied to interpret this Ds current system, on the assumption that the main source of electromotive force generation is due to the enhancement of electrical conductivity in the polar region. The change at a SC is so abrupt (within a few minutes) that it is resonable to assume that the wind system in the ionosphere will not change. Thus, using the wind system estimated from the Sq field, the current system at the time of commencement of the storm has been computed, assuming an appropriate change in the electrical conductivity. Good agreement with observed results was obtained, and it suggests that a dynamo action in the upper atmosphere is the dominant cause of geomagnetic variations during disturbances. Moreover, there was found a consistent wind system that can produce the observed geomagnetic variations both for quiet and disturbed conditions with a reasonable range of conductivity changes in the polar regions. This wind system consists of both a diurnal and a semidiurnal terms, and the estimated order of magnitude agrees with recent ionospheric measurements. A.

550.385 : 523.75

5530. GEOMAGNETIC DISTURBANCES ASSOCIATED WITH SOLAR FLARES WITH MAJOR PREMAXIMUM BURSTS AT RADIO FREQUENCIES ≤ 200 Mc/s. H.W.Dodson and E.R.Hedeman.
J. geophys. Res., Vol. 63, No. 1, 77-96 (March, 1958).

Study of world-wide solar and geomagnetic data has shown a close association between flares with "major early bursts" at radio frequencies ≤ 200 Mc/s and sudden-commencement geomagnetic storms. Intercomparison of Hα and radio-frequency solar data for January 1949 to April 1956 has given positive evidence for such "major early bursts" with 115 of the approximately 3000 flares observed during the 7¼ year interval. This type of radio-frequency event is, therefore, relatively rare. Geomagnetic storms were reported by at least one observatory within less than five days after the occurrence of 92% of the 115 flares with "major early bursts". The average time interval between the flare and the start of the subsequent geomagnetic storm was slightly less than 2½ days. Average superposed values of Kp and Ap were high on days 2, 3 and 4 after flares of importance 3 with "major early bursts", but this was not the case after flares of importance 3 when emission at frequencies ≤ 200 Mc/s was not present or occurred only in the post-maximum phase of the flare. The possibility of a "central meridian effect" was investigated. The average, superposed values of Kp for the disk passage of the 77 regions concerned is very similar to that "predicted" for disk passage of active regions with storm-producing flares in random positions, and with double frequency and/or effectiveness for the five days nearest central meridian passage. The latter assumptions are in accordance with observations. The geomagnetic effectiveness of each of the 115 flares with "major early bursts" was re-evaluated on the basis of all available world-wide solar data. Sixty-eight of the 115 flares were considered to be the most probable single solar cause of 68 geomagnetic storms. Study of these 68 cases of well-associated flares and geomagnetic storms indicated that storm-producing flares occurred at all meridian distances and in all importance categories. However, centrality of position and high flare importance favoured greater severity in the subsequent storm. Again, the average time interval between flare and start of storm was 56 hours. A.

550.385 : 523.75

SUDDEN DISAPPEARANCES OF SOLAR FILAMENTS AND GEOMAGNETIC STORMS. See Abstr. 4655

ATMOSPHERE. METEOROLOGY

551.510.3 : 551.524.7 : 551.547

5531. ON A PITOT-TUBE METHOD OF UPPER-ATMOSPHERE MEASUREMENTS. Vi-Cheng Liu.
J. geophys. Res., Vol. 61, No. 2(1), 171-8 (June, 1956).

The aerodynamic basis of using Pitot-tube pressures at supersonic speeds as an indirect measurement of the upper atmospheric density, pressure, and temperature, up to 80 km, is discussed. A special method of deducing these ambient variables from corresponding Pitot-tube pressures and other relevant parameters is presented. A unique feature of the method is that it needs only the Pitot-tube pressure and the corresponding forward velocity of the Pitot tube (assuming negligible atmospheric wind-velocity) to determine the ambient variables. This simplification is made possible by invoking laws that describe the characteristic properties of the atmosphere. This simplification, in the physical sense, results in an integral equation for the ambient density. A special and effective method is developed for the solution of this equation. A.

551.510.3

5532. "MOLECULAR WEIGHT" OF AIR AT HIGH ALTITUDES. L.E.Miller.
J. geophys. Res., Vol. 62, No. 3, 351-65 (Sept., 1957).

A method is described for obtaining the so-called "molecular weight" of air at high altitudes of the earth's atmosphere above the transition region for the dissociation of molecular into atomic oxygen. A reasonable working model is presented, based upon the ratio of absolute temperature to molecular weight T/M, which is proportional to the slope of the $\log_e$ pressure v. altitude curve. The region considered is from 90 to 600 km, assuming that the composition of the atmosphere is constant up to 90 km. The calculations are based upon experimental data. Knowing the composition of the atmosphere at any altitude, it is possible to determine the temperature through the relationship of the scale height to temperature: $H = RT/Mg$. A.

551.510.42 : 515.513

5533. DISPERSAL OF DUST PARTICLES FROM ELEVATED SOURCES. II. LIMITATIONS OF THE APPROXIMATE THEORY. G.T.Csanady.
Austral. J. Phys., Vol. 10, No. 4, 558-64 (Dec., 1957).

For Part I see Abstr. 5550 (1956). The solution obtained in Part I was an approximate one; its limits of validity are discussed in detail in the present paper. A generalization of this solution is discussed and two charts are presented to aid calculation of the "mirror image multiplier", the basic function of the approximate theory. A.

551.510.535

5534. OBSERVATION OF IONOSPHERIC WIND. E.Harnischmacher.
Ann. Télécomm., Vol. 12, No. 5, 159-61 (May, 1957). In French.

The results of observations made at Neuf-Brisach (France), Cambridge (England) and Kootwijk (Netherlands) are compared. A good correlation appears to exist between the values found for the direction of the wind, but the correlation is much less good for the velocities. A detailed report of the work is to be published by the U.R.S.I./A.G.I. commission. Typical records are here reproduced and discussed. See also Abstr. 2860 (1957), and Abstr. 6162 (1954). A.Wilkinson

551.510.535

5535. IONOSPHERIC DRIFTS AT BRISBANE.
M.J.Burke and I.S.Jenkinson.
Austral. J. Phys., Vol. 10, No. 3, 378-86 (Sept., 1957).

Examination of fading of signals recorded at closely spaced receivers was used to measured the velocity of horizontal drifts of ionization in the ionosphere. Systematic observations were made for a period of 2 years, on a frequency of 2.28 Mc/s. The results show good agreement with the horizontal velocities of ionized irregularities in the E and F2 regions of the ionosphere as determined by other methods at similar latitudes. The speeds are less than those observed at higher latitudes. The results for the E region were analysed for 24, 12 and 8 hr solar harmonics. The 12 and 8 hr harmonics show large seasonal phase changes in the northward component. The phase for the 12 hr northward component is in fair agreement with the results at higher latitudes in summer only, whereas the phase for the eastward component is generally consistent with the results at higher latitudes for all seasons. A.

551.510.535

5536. ANOMALIES IN IONOSONDE RECORDS DUE TO TRAVELLING IONOSPHERIC DISTURBANCES. L.H.Heisler.
Austral. J. Phys., Vol. 11, No. 1, 79-90 (March, 1958).

Anomalies, which frequently appear on ionosonde records of the F region during the passage of travelling disturbances, are classified into four main types, and the diurnal and seasonal distribution of their occurrence is discussed. It is suggested that the type of anomaly appearing on records depends on the ion density distribution at a height of about 200 km, which appears to be an upper bounding surface for the mode of travel of disturbances. A particular study has been made of winter disturbances. These are found to be so frequent that they affect all ionosonde records obtained during this season. They travel distances of at least 3000 km with fronts possibly broader than 1000 km. Attempted correlation with geomagnetic storminess was unsuccessful. Information is also presented on similar disturbances observed in North America. A.

551.510.535

5537. TRAVELLING IONOSPHERIC DISTURBANCES IN THE F REGION. G.H.Munro.
Austral. J. Phys., Vol. 11, No. 1, 91-112 (March, 1958).

Observations of the horizontal movements of travelling ionospheric disturbances recorded on a single radio frequency from April 1948 to March 1957 are analysed for seasonal and diurnal variations of occurrence and of direction and speed of travel. Recording was mainly in daylight hours but some limited night results are included. The average number of disturbances recorded was six per day over the period. Observing accuracy and significance of the deduced data are discussed. The frequency of occurrence has a diurnal variation with a marked midday maximum and a seasonal variation with minima at the equinoxes. The monthly means of direction of travel show a consistent seasonal change from 30° in winter to 120° in summer with a small corresponding change in mean speed from 8 km/min in winter to 7 km/min in summer. The monthly mean diurnal variation of directions was consistent from 1950 to 1954, but has shown a marked change in the last two summers. Winter directions by day are mainly in the north-east quadrant and have a mean day-time drift towards the north, but at night they are predominantly in the north-west quadrant. Summer day-time directions were mainly in the south-east quadrant until December 1956; since then they have tended to the south-west after noon, reverting to the south-east about midnight. Diurnal variation of speed is of the same order as the seasonal change. A.

551.510.535

5538. CALCULATION OF CHARGE DENSITY DISTRIBUTION OF MULTILAYERS FROM TRANSIT TIME DATA.
J.Shmoys and S.N.Karp.
J. geophys. Res., Vol. 61, No. 2(1), 183-91 (June, 1956).

An integral relation is derived between the electron density distribution of a multilayer and the frequency dependence of the time in which a radio pulse traverses the layer. This integral equation is then solved for the electron distribution by means of the Mellin transform, given the transit-time function. The lack of uniqueness of this solution is discussed. Certain characteristics of the multilayer, for example, the minimum electron density, are given in terms of the Mellin transform of the transit time. A.

551.510.535

5539. TURBULENCE IN THE IONOSPHERE WITH APPLICATIONS TO METEOR-TRAILS, RADIO-STAR SCINTILLATION, AURORAL RADAR ECHOES, AND OTHER PHENOMENA
H.G.Booker.
J. geophys. Res., Vol. 61, No. 4, 673-705 (Dec., 1956).

The irregularities in electron-density responsible for incoherent scattering of radiowaves in the ionosphere are discussed on the assumption of isotropic turbulence in the neutral molecules, with allowance made for the effect of the earth's magnetic field on the associated irregularities in the density of the charges particles. The atmospheric model used is based on rocket observations, extrapolated upwards in height where necessary. Tentative formulae are deduced for the large eddies based on a non-standard application of the Richardson number. For the small eddies, the standard formulae of turbulence-theory are used. A.

551.510.535

5540. A POSSIBLE TROPOSPHERE–IONOSPHERE RELATIONSHIP. S.J.Bauer.
J. geophys. Res., Vol. 62, No. 3, 425-30 (Sept., 1957).

Minimum virtual height and critical frequency of the ionospheric F2-layer are analysed by means of the superposed epoch method. Results of this analysis, on the basis of their statistical significance, suggest a relationship between frontal passage in the troposphere and F2-layer characteristics. The observed effects are interpreted qualitatively in the light of a hypothesis suggested by Martyn, and seem to be consistent with the concept of dynamic coupling between lower and upper atmosphere. The results of this analysis are also found to agree with previously reported troposphere-ionosphere correlations. A.

551.510.535 : 523.75

5541. DISTURBANCES IN THE LOWER IONOSPHERE OBSERVED AT VHF FOLLOWING THE SOLAR FLARE OF 23 FEBRUARY 1956 WITH PARTICULAR REFERENCE TO AURORAL-ZONE ABSORPTION. D.K.Bailey.
J geophys. Res., Vol. 62, No. 3, 431-63 (Sept., 1957).

Observations at the time of the great solar flare of 23 February 1956 of oblique-incidence signal intensities and simultaneous observations of the background cosmic noise were made at v.h.f. for a number of high-latitude communication links employing the ionospheric-scatter mode of propagation. During the flare and for some hours afterward, all paths lay in the dark hemisphere. Virtually synchronously with the arrival of solar cosmic rays, a sharp signal-intensity enhancement was observed, which is tentatively explainable if it is supposed that the first-arriving solar cosmic rays were predominantly of positive charge. The unusually stable night-time absorption, which developed in 1 to 3 hrs after the flare, and the much greater, following daytime absorption are explained in some detail as consequences of the deposition in the D region of moderately heavy solar atomic ions, such as calcium, having ionization potentials low compared with the normal atmospheric constituents. The absorption effects, which were limited to fairly high geomagnetic latitudes, gradually died away over a period of several days. The absence of significant magnetic disturbance and unusual auroral activity for nearly 48 hr after the flare is shown to be in accord with the suggested explanation of the absorption effects. Asymmetry about local noon was observed in the absorption effects on signal intensity, for which an explanation is suggested. A.

551.510.535

5542. DIFFERENTIAL ABSORPTION IN THE D AND LOWER-E REGIONS. J.C.Seddon.
J. geophys. Res., Vol. 63, No. 1, 209-16 (March, 1958).

A method of measuring electron densities in the D region making use of the Faraday effect is given. At noon on a day of high absorption, 2000 electrons/cm³ were measured at White Sands Proving Ground, New Mexico, at an altitude of 76 km. The technique also makes possible the determination of the differential absorption, by measuring simultaneously the sum and difference of the amplitudes of the two magneto-ionic components at 7.754 Mc/s as the rocket rolls. None was found over the range 60 to 88 km. A slow increase then occurred up to 94 km, whereupon it increased very rapidly to a value of $\frac{1}{2}$ per km at 96 km. Experimental difficulties prevented higher altitude measurements. A.

551.510.535

5543. MEASUREMENT OF THE IONOSPHERIC FARADAY EFFECT BY RADIO WAVES REFLECTED FROM THE MOON.
T.B.Daniels and S.J.Bauer.
Nature (London), Vol. 181, 1392-3 (May 17, 1958).

Preliminary report on measurements of the change in total electron content of the ionosphere during the night using the rotation of the plane of polarization of radio echoes on a frequency of 151 Mc/s reflected from the moon. The results indicated a change about 1.2 times that computed for a parabolic layer using vertical sounding data recorded at the transmitting site. G.M.Brown

551.510.535

5544. STUDY OF THE ION COMPOSITION OF IONIZED LAYERS OF THE ATMOSPHERE. B.A.Mirtov and V.G.Istomin.
Uspekhi fiz. Nauk, Vol. 63, No. 1b, 27-38 (1957). In Russian.

A general review is presented, with emphasis on the apparatus for the direct investigation of the ion content of the upper atmosphere. In particular, the Bennett-type r.f. mass-spectrometer and its experimental parameters are dealt with in some detail, together with the technical difficulties involved. C.R.S.Manders

551.510.535

RADIO-WAVE PROPAGATION IN THE IONOSPHERE. See also under "Electromagnetic waves and oscillations". Decimal classification 538.566.3

551.513.1

5545. INFERENCES CONCERNING THE DYNAMICS OF THE MESOSPHERE. R.G.Fleagle.
J. geophys. Res., Vol. 63, No. 1, 137-46 (March, 1958).

In earlier work, the development of large-scale atmospheric disturbances has been shown to depend in an explicit manner on horizontal density gradient, static stability, latitude, and dimensions of the disturbance. This theoretical analysis is generalized by eliminating the dimensions of the disturbance. The result is verified by comparing theory with tropospheric observations; then, on a reasonable postulate, the theory is applied to determination of the instability of small disturbances in the region between heights of 20 and 80 km, the mesosphere. The results indicate that in the statically stable mesoincline large-amplitude disturbances are limited to the polar regions and must develop slowly. In the statically less stable mesodecline, disturbances also are limited to the middle and high latitudes, but they may grow much more rapidly. The marked selectivity which the troposphere exhibits for disturbances 3000 to 7000 km in length occurs in the mesodecline in winter, but in summer there is only very weak preference for a wave number of two at about 55° latitude. It is inferred that summer disturbances in the mesodecline probably develop more rapidly than do disturbances in the troposphere, but that they undergo rapid change in form and size, so that they may quickly lose their identity. A.

551.515 : 538.566.2

5546. VERTICAL MOTION IN THE ATMOSPHERE AND ITS EFFECT ON V.H.F. RADIO SIGNAL STRENGTH.
W.F.Moler and W.A.Arvola.
Trans Amer. Geophys. Un., Vol. 37, No. 4, 399-409 (Aug., 1956).

The hypothesis is proposed that the vertical gradient of refractive index is strongly affected by the vertical motion in the atmosphere. It is shown that changes in this gradient are due principally to changes in the moisture stratification and temperature lapse rate resulting from the vertical velocity and its horizontal gradient within the air mass. Mean radio signal strengths are plotted against the time position of 500 mb troughs and ridges relative to the radio link. A series of 500 mb charts is given, with the vertical velocity field obtained by the Sawyer–Bushby method. The vertical velocity over two radio links is compared with the signal strength. Cross-sections taken through several of the troughs illustrate the stratification changes on the forward and rear sides of the troughs due to vertical motion. A.

551.521.326

5547. THE 5577 A EMISSION OF [OI] IN THE NIGHT AIRGLOW FROM SACRAMENTO PEAK, NEW MEXICO.
E.R.Manring and H.B.Pettit.
J. geophys. Res., Vol. 63, No. 1, 39-49 (March, 1958).

From a photometric study of the 5577 A airglow, made during 125 nights, extending over a two-year period, from Sacramento Peak, New Mexico, the following conclusions can be drawn. (1) The regular features form a diurnal and seasonal repetitive pattern, for which the intensity during the equinoxes is brighter than during the solstices. A diurnal and seasonal variation in the direction and amplitude of the maximum intensity is observed. This suggests a model which supposes that an intensity pattern exists on the dark side of the earth. The diurnal variation at an observing station would be due to the earth's rotation and the seasonal variation due to the change in position of the ecliptic plane with respect to the observing station. (2) The two most important sporadic features observed were arc-like structures, which appeared during six nights, and portions of auroral activity, observed during four nights. (3) From the 68 nights suitable for van Rhijn height determinations, a ratio of $I(75)/I(0) = 2.555$, corresponding to a height of 85 ± 68 km, was determined. (4) The triangulation attempt was made between Sacramento Peak and Capillo Peak, with a height between 80 and 100 km indicated. A.

551.578.13 : 523.531

5548. RELATION BETWEEN METEOR SHOWERS AND THE RAINFALL OF AUGUST, SEPTEMBER, AND OCTOBER.
E.G.Bowen.
Austral. J. Phys., Vol. 10, No. 3, 412-17 (Sept., 1957).

The rainfall of approximately 300 stations over the globe during the 3 months August, September and October show departures from the mean which are similar in character to those previously reported for the months November, December and January. Peaks in the rainfall curve occur on the average 31 days after meteor showers, in good agreement with the value of 30 days arrived at for November, December, and January. One of the best known meteor showers of the whole year, namely the Perseids, occurs during the period examined. This is a long-enduring stream which maximizes from 10 to 14 August. Commencing 31 days later is the most prominent rainfall peak of the whole year, extending from 10 to 24 September. A.

551.578.4 : 551.594.14

5549. Be^7 CONTENT IN SNOW. R.Nilsson, K.Siegbahn, A.Berggren and B.Ingelman.
Ark. Fys., Vol. 11, Paper 38, 445-51 (1957).

The radioactive isotope Be^7, which is produced in the atmosphere by cosmic radiation, was extracted from collected snow samples by means of ion exchange. The intensity of the Be^7 radiation was measured with a scintillation spectrometer. The average concentration of Be^7 atoms in the three snow samples was 4.3×10^3 atoms/cm^3 (volume of water). A.

551.594.1

5550. MEASUREMENT OF ELECTROSTATIC FIELDS IN THE UPPER LAYERS OF THE TERRESTRIAL ATMOSPHERE.
I.M.Imyanitov.
Uspekhi fiz. Nauk, Vol. 63, No. 1b, 267-82 (1957). In Russian.

A description, with block schematics illustrating working principles, is given of an apparatus (insulated body), for measuring field intensity. The peculiarities of its functioning when in a conducting medium (plasma) are also discussed. C.R.S.Manders

551.594.11

5551. AIRBORNE MEASUREMENT OF [THE FAIR WEATHER] ATMOSPHERIC POTENTIAL GRADIENT. J.F.Clark.
J. geophys. Res., Vol. 62, No. 4, 617-28 (Dec., 1957).

Grounded-rotor induction-type electric field meters were mounted horizontally at the wing tips and vertically at the bottom of the fuselage of an aeroplane. The measurement was corrected for the electric field distortion due to the aircraft itself by comparing observed values of potential gradient and conductivity at the earth's surface and at various altitudes during low-altitude flights over a portable ground station. A typical altitude distribution of potential gradient observed during clear weather at 67°N latitude is integrated to obtain a value of atmospheric potential, at a 6 km altitude, of 220 kV relative to the earth's surface. A.

551.594.13

5552. THE AIRBORNE MEASUREMENT OF ATMOSPHERIC CONDUCTIVITY. J.H.Kraakevik.
J. geophys. Res., Vol. 63, No. 1, 161-9 (March, 1958).

The simultaneous measurement of both polar conductivities using two Gerdien-type condensers is described. An altitude distribution of conductivity representative of clear arctic air is presented. From this distribution, a columnar resistance of 6.0×10^{16} ohm m^2 is obtained by integration from the earth's surface to 6 km. The average ratio of negative to positive conductivity was found to be 1.1. The charge on the aircraft was found to have negligible effect on the conductivity measurement for fair weather conditions. Triboelectric charging of the conductivity chamber central electrodes by aerosols was observed on most fair weather flights. Concurrent observations at the earth's surface occasionally exhibited the same effect. Even in its presence, techniques were used which permitted valid measurements of conductivity to be made. It is suggested that this effect may have been responsible for unusually high positive-to-negative conductivity ratios reported by others. A.

551.594.13

5553. SIMULTANEOUS MEASUREMENTS OF THE POSITIVE AND NEGATIVE LIGHT-ION CONDUCTIVITIES TO 26 KILOMETERS. R.H.Woessner, W.E.Cobb and R.Gunn.
J. geophys. Res., Vol. 63, No. 1, 171-80 (March, 1958).

Continuous simultaneous measurements of the positive and negative light-ion conductivities were made to altitudes of more than 26 km. Balloons carried aloft two nearly-identical, self-ventilated Gerdien tubes, 60 cm in diameter and 120 cm long, each connected to circuits which modulated a standard radiosonde transmitter. The operating signals for the positive and negative units are arranged to provide two different characteristic pulses. Critical tests showed that saturation effects in the measurement were eliminated. More than a thousand simultaneous measurements were made. It is found that the negative conductivity normally exceeds the positive conductivity at levels between 5 and 18 km. The altitude of the level of equal conductivity depends critically upon the cleanliness of the air and is commonly observed between 3 and 7 km. Below this level, the positive conductivity is normally in excess. It is found that the conductivity is represented by an expression of the form $\lambda = A \exp[\beta Z - \varphi Z^2 + \Omega Z^3]$, where the constants are different for the positive and negative conductivities. A.

551.594.5 : 550.385

5554. AURORAL AND MAGNETIC-STORM THEORY. W.H.Bennett.
Astrophys. J., Vol. 127, No. 3, 731-42 (May, 1958).

Experimental proof that the ionized interplanetary matter near the earth has a density of the order of 500 charge pairs/cm^3 invalidates the old Schuster, Lindemann, and Ferraro criticisms of charged particle-stream theories of the aurora. Experimental evidence is presented and analysed to show that none of the neutral ionized-stream theories can account for the principal broad characteristics of the aurora and magnetic storms. Arguments are presented to show that the magnetically self-focusing solar proton-stream modification of the original Birkeland–Störmer theory accounts for the principal characteristics of aurorae and magnetic storms quite naturally. Definite tests of the proton-stream theory are proposed. A.

551.594.5 : 537.591

LARGE AURORAL EFFECT ON COSMIC-RAY DETECTORS. See Abstr. 5085

551.594.51

5555. HYDROGEN IN AURORAS. C.W.Gartlein and G.Sprague. J. geophys. Res., Vol. 62, No. 4, 521-6 (Dec., 1957).

Auroral spectrograms showing hydrogen lines were studied. The velocity of incoming protons, as deduced from the Doppler shift, was used to calculate the penetration of the protons into the atmosphere. The penetration appears possible to the 115 km level. The intensity of hydrogen alpha was obtained (1) by comparison with the known intensity of oxygen radiation 5577 A of the normal night sky; (2) by calculation from characteristics of the photographic emulsion; and (3) by calculation from the total intensity of auroral light. These methods agree within an order of magnitude. The H-alpha flux is about 10^{-4} erg per cm^2 column per sterad per sec. A.

551.594.52

5556. U.H.F. RADAR OBSERVATIONS OF AURORA. S.J.Fricker, R.P.Ingalls, M.L.Stone and S.C.Wang.
J. geophys. Res., Vol. 62, No. 4, 527-46 (Dec., 1957).

Radar returns from aurora were observed on a 412.85 Mc/s pulsed bistatic radar, located at South Dartmouth, Mass. Results obtained during two observational periods, 19 September to 6 October 1956, and 29 November to 21 December 1956, are given in terms of occurrence and position data, together with typical returns obtained on an A-scope and with range-time intensity modulated displays. Positions of observed returns are compared with positions computed on the basis of requiring beam perpendicularity to the earth's magnetic field. Indications are that returns may be obtained from regions which are 2° to 3° off perpendicular, and that returns at larger off-perpendicular angles may be limited by a height factor. The returns appear to be limited to the height range of 90 to 160 km approximately. A.

551.594.6 : 621.396.821

5557. A STUDY OF THE AUDIO-FREQUENCY RADIO PHENOMENON KNOWN AS "DAWN CHORUS". G.McK.Allcock.
Austral. J. Phys., Vol. 10, No. 2, 286-98 (June, 1957).

The main characteristics of dawn chorus, as observed at Wellington, New Zealand, between July 1955 and October 1956 are presented. These are: no general correlation with whistlers; a strong correlation with simultaneous local magnetic variations; a pronounced diurnal variation in activity, with the peak occurring near 0400 hr local time; and possibly a weak seasonal variation in activity. The correlation of observations of dawn chorus at Wellington with those at other places is discussed. It is concluded that dawn chorus signals are propagated along lines of force of the earth's magnetic field, and that the signals are probably initiated by the entry of charged solar particles into the outer ionosphere at times of magnetic disturbance. A.

BIOLOGY

MEDICAL SCIENCE. HUMAN PHYSIOLOGY

611.71 : 537.228.1

THE PIEZOELECTRIC EFFECT OF BONE. See Abstr. 4944

612.843

5558. SUMMATED RESPONSE OF THE RETINA TO LIGHT ENTERING DIFFERENT PARTS OF THE PUPIL. J.M.Enoch.
J. Opt. Soc. Amer., Vol. 48, No. 6, 392-405 (June, 1958).

Contradictory additivity data of previous investigators, defined as the summated response of the retina to light entering different parts of the pupil, have led to an intensive study of variables inherent in these measurements. The experimental results have demonstrated that the Maxwellian and the ordinary type of viewing may be used interchangeably in Stiles–Crawford and additivity effect experiments. The experiments conducted in the present work revealed that additivity data are affected by at least the following two factors: the Stiles–Crawford effect and the blur of the retinal image. When blur is eliminated in addivity studies, the Stiles–Crawford effect does not reduce perceived brightness as much as might be predicted. The blur effect, caused by ocular aberrations, spherical and chromatic aberrations in particular, is a variable dependent upon the observer. This variability is thought to account for the several discrepancies in the data found in the literature. Experiments concerning the effect of blur on perceived brightness have been completed. It was shown that blur reduces perceived brightness of a field, and the degree of the reduction is dependent upon the test method. A.

612.843

5559. LUMINOSITY FUNCTIONS FOR VARIOUS FIELD SIZES AND LEVELS OF RETINAL ILLUMINANCE. R.E.Bedford and G.W.Wyszecki.
J. Opt. Soc. Amer., Vol. 48, No. 6, 406-11 (June, 1958).

Luminosity functions were measured for four normal trichromats for three field sizes (1°, 12', 1.5') at various levels of retinal illuminance. As the illuminance decreases the reverse Purkinje effect is observed, i.e., there is a decrease in spectral sensitivity of the eye to blue relative to red. The dependence of the spectral sensitivity on field size is not pronounced for the experimental conditions used here. Considerable differences are found between the luminosity functions of the observers. These differences are several times larger than those obtained on repeated curves by any observer. It is shown that the use of an average luminosity function may give very misleading results in some cases. A comparison is made with the data obtained by previous workers. A.

612.843.16

5560. LUMINANCE-DURATION RELATIONSHIPS IN THE LIGHT-ADAPTED ELECTRORETINOGRAM. W.R.Biersdorf.
J. Opt. Soc. Amer., Vol. 48, No. 6, 412-17 (June, 1958).

The applicability of the Bunsen—Roscoe law to the components of the human electroretinogram was investigated under conditions of moderate light adaptation. Simultaneous X and B waves were obtained with red test stimulation and A and B waves with white test stimulation. Both response amplitude and implicit time were measured. The A and X waves were found to adhere to the Bunsen—Roscoe law and have relatively constant implicit times. The response amplitude of the B waves showed systematic departures from a simple Bunsen—Roscoe model and their implicit times varied with both stimulus duration and luminance. A.

612.843.16

5561. LOCALIZED ELECTRORETINOGRAMS FROM THE ISOLATED RETINA OF THE FROG. D.Hamasaki and E.Marg.
J. Opt. Soc. Amer., Vol. 48, No. 6, 418-21 (June, 1958).

A technique of recording localized electroretinograms (E.R.G.s) with macroelectrodes is described. The localized E.R.G. showed a typical a wave and b wave which confirmed the idea that the E.R.G. can be a response to a focal as well as a nonfocal stimulus. An electroretinographic map of the retina is shown. At the optic nerve head the E.R.G. is absent or is markedly reduced in amplitude. The change in the amplitude of the b wave from the central area to the periphery is not smooth; on the contrary, abrupt changes in the amplitudes were found. An area in the inferior half of the retina was found which gave large amplitude E.R.G.s. This area was seen in all of the retinas plotted although its exact shape and size varied. A.

612.843.2

5562. DEPENDENCE OF THE EFFECTIVE BRILLIANCE ON BACKGROUND LUMINANCE. A.V.Luizov and K.N.Bulanova.
Svetotekhnika, 1957, No. 7, 17-19. In Russian.

The effective brilliance (E_{eff}) of a flashing source of light is equal to the brilliance (illumination of the observer's pupil, E) of a constant light source which appears to have the same luminance as the flashing source; it depends on the brilliance and duration of the the flash (τ). Further to the study (Abstr. 2897/1957) in which flashes took place on a dark background, the authors made similar measurements for backgrounds of various luminance. The duration of the flashes varied from 0.05 to 2.5 sec, and the brilliance of each flash was selected so as to yield, for a given τ, the same effective brilliance for all flashes. Results of measurements, using an apparatus which is illustrated and described, showed that, for any background luminance (including the dark background), the amount of brilliance (H) depends linearly on τ, $H = [E\tau] = E_{eff}(\theta + \tau)$, where θ is a parameter varying from 0.077 sec for the dark background to 0.033 sec for the background luminance of 32 nit.

F.Lachman

612.843.2

5563. BASIS FOR JUDGMENTS OF RELATIVE BRIGHTNESS.
R.M.Warren and R.P.Warren.
J. Opt. Soc. Amer., Vol. 48, No. 7, 445-50 (July, 1958).

The hypothesis is offered that relative brightness judgments are based upon experiences with the way the amount of light reflected by objects changes with their distance from the light source. The experimental results support this hypothesis. One group of 40 subjects judged half brightness, and another 40 estimated the change in luminance corresponding to moving a hidden point light source to twice the distance from an illuminated standard field. Judgments of the two groups were equivalent. Under stimulus conditions designed to represent the common visual situation (stimuli subtending wide visual angles, adaptation approximating stimulus levels), one quarter the standard luminance was correctly chosen for the effect of doubling distance from the source, and the same fraction was chosen for half brightness for all standard intensities (0.00086 to 87 millilamberts). Under less familiar conditions similar to those employed for the bril scale (small stimuli with black backgrounds, indeterminate levels of adaptation) half brightness judgments were again equivalent to estimates of the effect of doubling distance from object to light source. These estimates were less than one-quarter standard luminance. The hypothesis is discussed in terms of sensory scaling in general, and the neutral value and bril scales in particular. A.

612.843.613

5564. RELATIONSHIP BETWEEN STIMULUS SIZE AND THRESHOLD INTENSITY IN THE FOVEA MEASURED AT FOUR EXPOSURE TIMES. B.M.Hillmann.
J. Opt. Soc. Amer., Vol. 48, No. 6, 422-28 (June, 1958).

An experimental determination was made of absolute visual thresholds in the human fovea. An apparatus permitting independent variation of area and exposure time, and having a fixation device that minimally affects the adaptation level of the region under investigation was used. Seven stimulus areas, ranging from 1 minute to 1 degree in diameter were presented to 4 subjects at durations of 1.1, 3.8, 10.0, and 48.0 milliseconds. The results show that all area-threshold functions depart from Ricco's law. The functions which were obtained depart from linearity, while the degree of curvature varies among subjects. As exposure time is increased there is a regular decrease in thresholds for all stimuli. This decrease in threshold is in good agreement with the Bunson—Roscoe law, which states that the product of time and intensity is a constant. A.

612.843.613

5565. A THEORY OF VISUAL THRESHOLDS.
F.H.C.Marriott; R.L.Gregory and V.R.Cane.
Nature (London), Vol. 181, 1487-8, 1488 (May 24, 1958).

A fallacy in Gregory and Cane's formula (Abstr. 4129/1956) is pointed out by Marriott, and discussed by the authors.

R.A.Weale

612.843.72

5566. INTERRELATION OF MONOCULAR AND BINOCULAR ACUITIES IN THE MAKING OF AN EQUIDISTANCE JUDGMENT.
G.S.Harker.
J. Opt. Soc. Amer., Vol. 48, No. 4, 233-40 (April, 1958).

Experimentation was undertaken to demonstrate that the depth acuity for panel test objects is complex and can be considered to be a combination of the acuities for monocular or congruent and binocular or disparate stimulation. Probability addition to combine the two contributing acuities produced a reasonable fit of the empirical data. A generalization to the natural environment of the trigonometric relation of the acuity for the alignment of horizontal edges to the acuity for depth was not consistent with results reported in the literature. A concept of equivalent-parallactic-angle acuity was offered, in conjunction with the known improvement in acuity with reduction in angular separation of the acuity objects, as an explanation of the reported improvement in stereoscopic acuity with distance. In contradistinction to implications in the literature, this research indicates that stereoscopic vision remains as the indicator of depth relations after cues available in monocular vision have ceased to be effective, if situational factors favouring the utility of monocular vision are controlled. A.

612.846

5567. EYE FIXATIONS RECORDED ON CHANGING VISUAL SCENES BY THE TELEVISION EYE-MARKER.
J.F.Mackworth and N.H.Mackworth.
J. Opt. Soc. Amer., Vol. 48, No. 7, 439-45 (July, 1958).

By the use of television techniques it is possible to record the position of a man's gaze upon a picture of the scene at which he is looking. The corneal reflection of a light is picked up by a television camera, which magnifies the movement of the spot about 100 times. The scene at which the man is gazing is provided by a second television camera, and the corneal reflection is superimposed upon another television monitor also showing the same scene. By suitable calibration, this spot can be made to lie upon that part of the scene being regarded and the accuracy with which this can be done is within one or two degrees. Thus it is possible to see where a man is looking at any moment, and simultaneously to record the composite eye-scene picture by means of a motion picture camera. In addition to its practical uses, this method is particularly useful for answering such general questions as whether a subject always sees what he is directly looking at, what kind of cues catch his attention when he is searching, and what sort of changes in a display catch his attention. It is primarily intended for use with a moving display, as it records the point of view directly on to each state of the display. Successive glances therefore indicate the order in which particular parts of complex displays are selected, as well as the exact movement at which the gaze changes to a new position. A.

612.85

5568. HEARING LEVEL, HEARING LOSS, AND THRESHOLD SHIFT. H.Davis, G.D.Hoople and H.O.Parrack.
J. Acoust. Soc. Amer., Vol. 30, No. 5, 478 (May, 1958).

Excerpt from a previously published paper (A.M.A. Archives of Industrial Health, Vol. 17, 1-20, 1958) defining and recommending for general usage the three different terms in the title.

H.D.Parbrook

616-001.28 : 551.594.12

5569. THE CONTROL OF AIR IONIZATION AND ITS BIOLOGICAL EFFECTS. W.W.Hicks and J.C.Beckett.
Trans Amer. Inst. Elect. Engrs I, Vol. 76, 108-11 (1957) = Commun. and Electronics, No. 30 (May, 1957).

It has been established that ionized atmospheres have demonstrable effects on human beings as well as on animals. An explanation of these effects have been sought more recently at the cellular level, where results to date show significant changes. Investigation is proceeding on all levels for the purpose of clarifying results already observed and establishing dosage and other techniques which will make artificial ionization a valuable resource for human well-being. A.

TECHNIQUE. MATERIALS

666.1 : 533.59

5570. SILICA GLASS, VITREOUS SILICA AND A GLASS SIMILAR TO SILICA GLASS AS MATERIALS FOR HIGH-VACUUM TECHNIQUES. W.Espe.
Slaboproudý Obzor, Vol. 18, No. 4, 266-80 (1957). In Czech.

The physical and chemical characteristics of these glasses are dealt with in detail. Various applications are indicated.

R.S.Sidorowicz

PHOTOGRAPHY

771.535 : 537.226.32 : 537.312.5

LATENT ELECTROPHOTOGRAPHIC IMAGE. See Abstr. 3132

778.33

5571. THE ESTIMATION OF THE TECHNICAL QUALITY AND INFORMATION-CONTENT OF X-RAY PHOTOGRAPHS BY INSPECTION OF THEIR AUTOCORRELOGRAMS.
W.Schröck-Vietor.
Naturwissenschaften, Vol. 45, No. 7, 155-6 (1958). In German.

A simple optical method of obtaining an autocorrelogram (or convolution of an X-ray picture with itself) is suggested, and its interpretation in terms of contrast and sharpness is explained.

A.R.Stokes

778.34

5572. PREPARATION OF NUCLEAR PHOTOGRAPHIC EMULSIONS FROM COLLOIDAL SILVER.
M.Morand, J.Colomer and C.Schœbel.
C.R. Acad. Sci. (Paris), Vol. 246, No. 12, 1847-9 (March 24, 1958). In French.

Describes results achieved by bromation of colloidal silver in gelatine up to 100 μ thick. The average grain size was only 50 A. Present chemical sensitization techniques allow α-particles to be recorded. E.J.Burge

778.34 : 539.12

SCATTERING MEASUREMENTS IN NUCLEAR EMULSION. See Abstr. 5171-2

778.37

5573. EFFECTS OF ELASTIC DISTORTION OF ROTATING MIRRORS ON TIME RESOLUTION IN SMEAR CAMERAS.
T.E.Holland and W.C.Davis.
J. Opt. Soc. Amer., Vol. 28, No. 6, 365-71 (June, 1958).

The basic relations for the rotating mirror smear camera are reviewed and expressions are obtained for the maximum time resolution obtainable in systems uncorrected for the elastic distortion of the mirror surface. Instrumentation for the measurement of the surface distortion at high speed is described and data are reported for rotating rectangular parallelepipeds as a function of size and width-to-thickness ratio. The central sections of the mirrors deform cylindrically, the power varying nearly with the square of the peripheral speed. The distortion effects can be almost completely compensated by the introduction of negative astigmatism into the system. An auxiliary optical system is described which aids in the adjustment of the corrector lens to obtain optimum resolution. A corrected system in current use has a time resolution of 10^{-8} sec with relative aperture f6. A.

LIST OF JOURNALS

The following list supplements the List of Journals published with the June number of Volume 60 (1957) and the Supplement published th the Index to the same volume. Reprints of the List of Journals and of the Supplement can be obtained from The Institution of Electrical ngineers, Savoy Place, London, W.C.2, price 2s.0d. post free.

The addresses given are believed to be correct at the date of publication, but no responsibility can be accepted for errors.

rit. Kinematogr.
British Kinematography. — The British Kinematographic Society, 164 Shaftesbury Avenue, W.C.2.

ull. Nat. Inst. Sci. India
Bulletin of the National Institute of Sciences of India. — Mathura Road, New Delhi.

.rc. Electrotech. Lab. [Tokyo]
Circulars of the Electrotechnical Laboratory. — 2-Chome, Nagatocho, Chiyoda-ku, Tokyo.

ernmelde-Ingenieur
Fernmelde-Ingenieur. — Verlag für Wissenschaft und Leben Georg Heidecker, Külsheimer Strasse 11, Windsheim (Mittelfr.)

.E.C. atomic Energy Rev.
G.E.C. Atomic Energy Review. — The General Electric Co.Ltd, Magnet House, London, W.C.2.

J. Math. and Phys.
Journal of Mathematics and Physics. — The Technology Press, Massachusetts Institute of Technology, Cambridge, Mass.

Práce Ustavu pro Elektrotech. ČSAV
Práce Ustavu pro Elektrotechniky CSAV. — Československa Akademie Ved, Narodni tř. 3, Prague.

Rev. de Physique [Bucarest]
Revue de Physique. — L'Academie de la Republique Populaire Roumaine. Editor: 125 Calea Victoriei, Bucarest.

Stud. Cercetari Fiz.
Studii si Cercetari de Fizica. — Academia Republicii Populare Romine, Bucarest.

NEW JOURNALS

ontrol
Control. — Rowse Muir Publications, 3 Percy Street, London, W. 1. Vol. 1, No. 1 dated July, 1958.

lect. Technol., U.S.S.R.
Electric Technology, U.S.S.R. — Pergamon Press, 4 and 5, Fitzroy Square, London, W. 1; 122 East 55th Street, New York 22, N.Y. Vol. 1 dated May, 1958.
[A translation of selected papers from the Russian journal Elektrichestvo.]

formation and Control
Information and Control. — Academic Press, 111 Fifth Avenue, New York 3. Vol. 1, No. 1 dated Sept., 1957.

hys. Metals and Metallography [U.S.S.R.]
Physics of Metals and Metallography. — Pergamon Press, 4 and 5 Fitzroy Square, London, W. 1; 122 East 55th Street, New York 22, N.Y.
[A translation of the Russian journal Fizika Metallov i Metallovedenie; the first issue is a translation of Vol. 4, No. 1.]

adio Engng [U.S.S.R.]
Radio Engineering. — Pergamon Press, 4 and 5 Fitzroy Square, London, W. 1; 122 East 55th Street, New York 22, N.Y.
[A translation of the Russian journal Radiotekhnika; the first issue is a translation of Vol. 12, No. 7].

Radio Engng and Electronics [U.S.S.R.]
Radio Engineering and Electronics. — Pergamon Press, 4 and 5 Fitzroy Square, London, W. 1; 122 East 55th Street, New York 22, N.Y.
[A translation of the Russian journal Radiotekhnika i Elektronika; the first issue is a translation of Vol. 2, No. 2.]

Rheology Abstracts
Published for the British Society of Rheology by: Pergamon Press, 4 and 5 Fitzroy Square, London, W. 1; 122 East 55th Street, New York 22, N.Y.
Vol. 1, No. 1 dated May, 1958.
[Replaces the abstract Section of the British Society of Rheology Bulletin.]

Telecommunications [U.S.S.R.]
Telecommunications. — Pergamon Press, 4 and 5 Fitzroy Square, London, W. 1; 122 East 55th Street, New York 22, N.Y.
[A translation of the Russian journal Elektrosvyaz'; the first issue is a translation of No. 1, 1957.]

NOTES

strumentation
Instrumentation. — English address changed to: Honeywell Controls, Ruislip Road, East Greenford, Middlesex.

Z. angew. Math. Phys.
Zeitschrift für angewandte Mathematik und Physik. — Volume 9 of this journal will be published in two parts: Vol. 9a will contain Nos. 1, 2, 3 and 4 and Vol. 9b has appeared with separate pagination in a double issue numbered 5-6 as the Festschrift Jakob Ackeret. Note that No. 1 has already been published as "Vol. 9".

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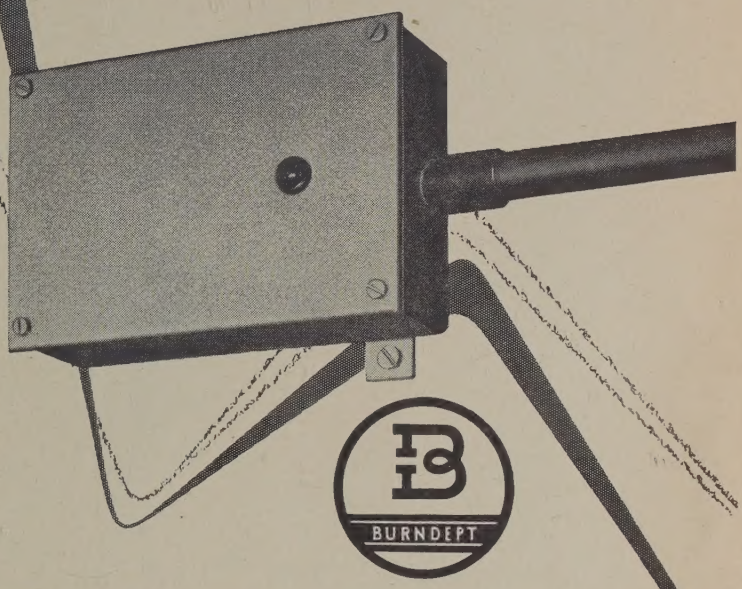

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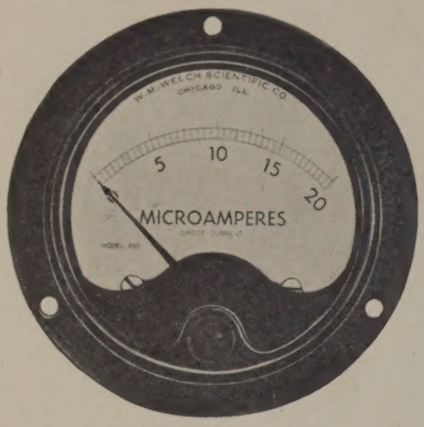

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